THE ELECTRICAL EXPERIMENTER

DEC. 1913

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THE E. I. Co. NEWS

The Fourth Annual Official Wireless BLUE BOOK

We are pleased to announce that we will publish on or before April 1st, the 4th annual Official Wireless Blue Book containing all the calls of the United States land, as well as sea stations, also a list of all the amateur radio stations in the United States. This book will be unprecedentedly large, **HAVING 96 PAGES** and will be the most complete book on wireless calls ever published in this country. It will contain all the amateur stations which have been registered by the Government as well as stations not registered, such as receiving stations. This is a very important publication and you cannot afford to be without it. So far we have over 1300 amateur applications and we trust that we will be able to publish yours too.

THE PRICE OF THE 4TH WIRELESS BLUE BOOK IS 15c. We think it is worth your while to be listed in this book.

The fee for listing your name, address, and station is 30c, and this includes one copy of the Blue Book which will be mailed to you upon publication of the book. The listing is consequently only 15c and we think it will be worth your while to expend this small amount of money to have your name listed in such an important publication.

Electro Importing Co.,
New York.
Gentlemen:—
Please find enclosed herewith

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for which please enter my name for the following:—

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If receiving station only put cross on this line.....

(If you have only a receiving station and you have no call, we will assign an official call to you.)

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On receipt of 75c we will extend the following SPECIAL OFFER to you:

1. We will send you **"THE ELECTRICAL EXPERIMENTER"** for one year commencing with the March Number.
2. We will list your name in the new Wireless Blue Book.
3. We will send you copy of the Blue Book when issued.

New listings for the 4th Official Wireless Blue Book **must positively be in our hands not later than March 15th.**

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THE ELECTRO IMPORTING CO.,
233 FULTON ST., NEW YORK

THE ELECTRO RADIOSON (Patents Pending)

"The Ultra Sensitive Electrolytic."

This Detector to-day represents the most sensitive one manufactured, without any exceptions whatsoever. It is far more sensitive than the Audion as well as the ordinary electrolytic detector and will bring in messages which cannot be heard at all by the former detectors.

The Radioson is the ontcome of long experimentation and it embodies several new as well as nnique features.

The Radioson is the only detector so far developed which needs no adjusting whatsoever. It cannot be "Knocked out" by nearby sending stations. It never loses its sensitiveness. **MESSAGES COME IN CLEAR AND DISTINCT EVEN WHILE THE DETECTOR IS SHAKEN VIOLENTLY.**

The acid as well as other parts are sealed in the detector proper. No spilling of acids. Absolutely clean and safe. The Radioson is adjusted to its highest sensitivity at the factory. It undergoes five different tests for sensitivity before the glass bulb is finally sealed. You cannot possibly bring it out of adjustment except if you smash it or pass a high tension discharge through it. The Radioson never requires attention. It is always ready for you. You never lose part of important messages on account of bothersome as well as annoying adjustments, common to EVERY other detector.

The Radioson is clean and compact and easy to handle. It works equally well on the shakiest table as on a concrete fonndation. For aeroplane work, on board of ship, on automobiles, on trains, or any place where there are violent vibrations, the Radioson is absolutely unmatched, not to mention its higher sensitiveness over other detectors. It is equally useful for Radiotelegraphy as Radiotelephony.

No potentiometer is required with the Radioson. The only necessary addition is two dry cells (3 volts). These may be of very minute size, as, for instance, two cells taken from a flashlight battery. (Onr No. 821 2-cell flashlight battery price 20 cents, is ideal.)

No. 9300

We only guarantee the Radioson in connection with a telephone headset of at least 2,000 ohms or higher ohmage. Lower resistance than 2,000 ohms will decrease the life of the detector.

The Radioson is absolutely guaranteed by us in all respects. We guarantee safe delivery to you, under all circumstances. We will furthermore refund your money to you upon proof that the Radioson is not more sensitive than any other detector existent to-day.

The Radioson is sold complete only as illustrated. Radioson exchange cartridges are only furnished to users of the instrument, if the original cartridge is returned to us either whole or broken.

Specifications: The Radioson comprises a heavy opal glass base. On this is mounted a very large solid hard rubber standard, which supports the heavy brass spring. The latter holds the detector proper in place by spring action. The Radioson cartridge is easily snapped in or out simply by pushing the spring upwards. There are two very large nickel binding posts. Size over all 4 x 2½ x 3½. Shipping weight 2 lbs.

All metal parts are triple nickel plated and highly polished. The instrument is extremely neat and has already been introduced in a number of commercial radio stations.

We guarantee satisfaction.

No. 9300 "Electro" Radioson Detector, complete.... **$4.50**
No. 9301 "Electro" Radioson Cartridge (see note above) **2.50**

On account of a great many complaints from our customers we have discontinued the sale of the Audion. We had so many complaints on burnt out filaments, poor sensitivity, uncertain working, bad vacuum, "flashing over," bent grids and wings, breakages, etc., that we thought it best, in the interest of all concerned to discontinue the sale of the Audion. We found that most people could not wire this complicated instrument, and as it required a 4 volt as well as a 40 volt battery and a Rheostat, it usually proved a white elephant on the hands of customers, the more so as it was impossible to guarantee the instrument on account of manufacturing difficulties.

H. GERNSBACK, Editor. H. W. SECOR, Associate Editor

THE ELECTRICAL EXPERIMENTER

VOL. I. DECEMBER, 1913 NUMBER 8

Dr. De Forest on the Audion Amplifier

AT the November meeting of the Institute of Radio Engineers, held at Columbia University, Dr. Lee de Forest, gave a lecture on the Audion Radio Detector. Some of the wonderful features of this form of detector, used for both radio and telephone work, as an amplifier or detector alone, were brought out and clearly demonstrated. Dr. de Forest has recently disposed of the audion amplifier patents to the Western Electric Co., for a large sum. They intend using it for amplifying long distance wire telephone talk, in an effort to link New York

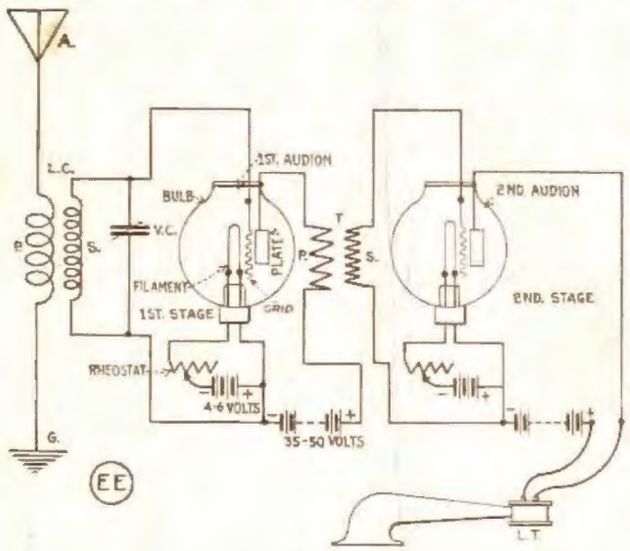

Fig. 1.

and 'Frisco together. The "Pupin Coils" have increased the long distance wire telephone range to such an extent, that one can now talk from New York to Denver; while the de Forest audion amplifier, bids fair to finish the good work already done, by increasing the talking distance to 3,800 miles; from New York to the coast.

During the lecture, varions demonstrations were given, showing the wonderful sensitiveness of the audion detector. A point brought out by the lecturer was that while all ordinary cymoscopes, such as the electrolytic or crystal rectifying detector, require some definite minimum received current, in micro-amperes, to operate them at all; no such law obtains for the audion. A radio signal might be so weak, that its relative strength would be far below the normal audibility value, but by means of a 2, 3 or 4 stage audion simplifier, these signals could be built up, so to speak, so that the signals are readily readable. Hence an audion amplifier set, will enable two radio stations to work together, where such a performance would be simply impossible with the ordinary crystal or electrolytic detectors. As a matter of fact the Los Angeles and San Francisco radio stations, using the Poulsen undamped wave system, of the Federal Telegraph Co., have prolonged their daylight working range several hours, by means of the audion amplifier. This means that, when the received signals grow so weak that they can not be detected at all, with the most sensitive ordinary receiving set; that the audion amplifier succeeds in picking up the waves and intensifying them until they are clearly audible in the receivers.

It has long been desired to have a reliable method of making a permanent record of the received long distance radio signals, by means of a relay actuating a tape register, etc., and thanks to the de Forest amplifier, this is now readily possible. Another modification of this recording and amplifying function, involves the use of a telegraphone, which records the received radio signals on a fine iron wire .01 inch diameter at any desired speed, as high as 80 words a minute if desired, and then the telegraphone is reversed; and the signals can be amplified through the audion three stage set, into a loud talking receiver, fitted with a horn. This was actually demonstrated at the meeting, much to the amusement and interest of those present. A number of radio station signals had been copied on the telegraphone at the de Forest Laboratory, through the audion amplifier, and when articulated through the loud talking receiver fitted with a horn, the familiar dots and dashes of some quite fancy "Morse," filled the large lecture hall. The general arrangement of the two stage audion amplifying set is shown here, schematically. Here "T" is a fairly high resistance, one to one ratio transformer, and "LT" is the loud talking receiver with horn. When the telegraphone is used, the radio telephone receiver is connected to the carbon grain microphone transmitter, of the recorder. The radio receiver is in the final circuit of the amplifier. A great feature of this arrangement is that the telegraphone signals can be reproduced at any speed, even as low as fifteen words per minute, if desired. The hook-up depicted here is

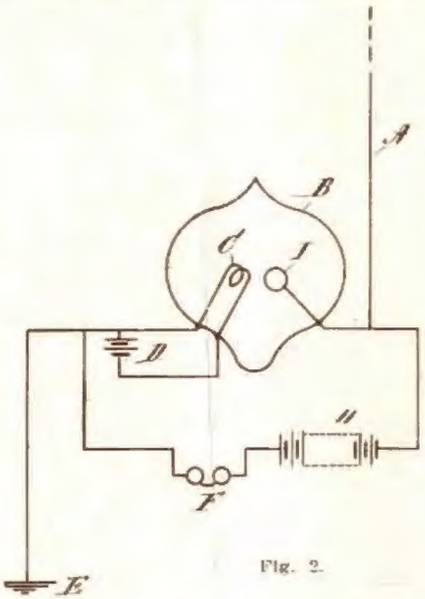

Fig. 2.

only a simple schematic one, to give a clearer idea as to the general arrangement of such a set. In the regular amplifier sets the audion bulbs are all of the double grid type,

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If you change your address, notify us promptly, in order that copies are not mis-carried or lost.

All communications and contributions to this journal must be addressed to: Editor, "The Electrical Experimenter," 233 Fulton Street, New York. We cannot return unaccepted contributions unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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i. e., each bulb has two grids and two plates, disposed on opposite sides of the tantalum filament. Both filaments are lighted at once in this type, and in the demonstration set, used by Dr. de Forest four audions of this type were utilized. Three stages were used, and the third and fourth audions were connected on parallel in the third stage of the amplification scheme. A gross amplifying factor of 120 times the initial energy in the 1st stage circuit, has been attained by Dr. de Forest. Using an ordinary Bell telephone receiver to pick up the sound, instead of a microphone transmitter; and by amplifying the sound currents through the 3 stage audion set, a sensitiveness to sound waves was attained which puts

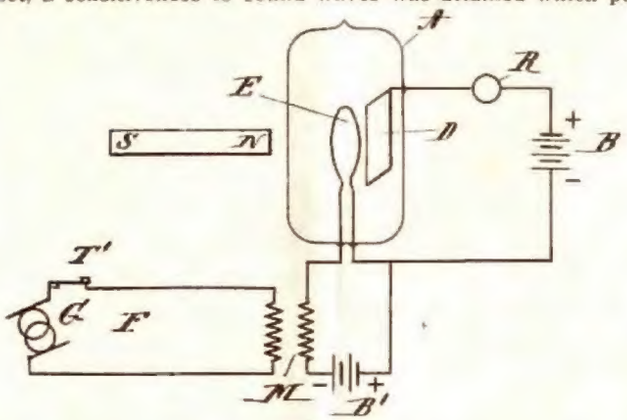


Fig. 3.

the best "Dictagraph" in the shade. Besides, this set, thus employed, does not have present the constant rumblings encountered in the ordinary dictagraph, due to the crude and imperfect action of the carbon grain microphone transmitter employed. There never has been a better and more perfect transmitter of the spoken voice, developed, than the original "Bell" magneto receiver, which is still in use (for receiving only now, however). Several questions were answered by the lecturer at the close of the meeting and Dr. John Stone Stone, who was present, said he had been interested in telephonic relays or amplifiers since 1892. At last, he declared, the practically perfect and inertialess amplifier (employing a stream of ionized gas), had been produced by Dr. de Forest. Its possibilities are very far-reaching, and, undoubtedly, it will find a wide range of usefulness in various branches of the Radio and Telephone Industry.

A brief resumé of some of the de Forest audion patents may be of more or less interest to the young radio student. One of the first basic patents taken out on the audion, and covering the philosophy of operation, is No. 836,070, issued Nov. 13, 1906. The sketch, Fig. 2, illustrates the principle covered in this patent.

"In the illustratiou, Fig. 2, A represents a receiving-antenna connected to earth at E and associated with the receptacle B. Two electrodes C and I are inclosed within this receptacle, which may be partially exhausted, and, as shown, they are sealed in it. The electrode C may be an ordinary incandescent-lamp carbon filament, which is connected with a battery or other source of electrical energy D. The electrode I may be any suitable conductor and is herein shown as a disk of platinum or other material. The gaseous medium inclosed between the electrodes C and I is rendered sensitive to electrical oscillations by the radiation of heat from the electrode C, said electrode being heated by the source of energy D. The local circuit containing the battery H or other source of electrical energy and the telephone F or other signal-indicating device is electrically connected with the electrodes C and I, and as shown is connected in series therewith. The antenna A may be associated with either electrode and in such case the other electrode may be connected to earth. It will be understood, however, that the particular mode of associating the oscillation responsive device with the antenna forms no part of this invention and that any suitable system of circuits may be employed with this oscillation responsive device.

The potential to be impressed upon the electrodes C and I by the battery H depends upon the nature of the gas intervening between said electrodes and upon the degree of exhaustion maintained within the receptable B. It has been found that from twenty-five to one hundred and ten volts direct current from a battery, not a dynamo, is sufficient; and by employing a higher degree of exhaustion a much smaller voltage may be used. The conductivity of the gas, which may be air, or a gas containing compounds of the halogens or halogen salts or which may be mercury vapor, is increased sufficiently to render said gas sensitive to the passage of electrical oscillations across the gap by the radiation of heat from the electrode C. The passage of electrical oscillations across said gap alters the conductivity of the gas in said gap, probably by changing the speed of the ions in said gas, and thereby current variations are produced in the circuit containing the battery H, the electrodes C and I, and the telephone F, causing said telephone to respond. When the telephone is in series with the battery H and the electrodes C and I, the passage of oscillations across the gap between said electrodes causes an increase of current through the telephone and if the telephone is connected in shunt with said electrodes, the passage of oscillations across the gap decreases the current through the telephone."

One of the basic de Forest patents on the "Audion Amplifier" is No. 841,387, issued Jan. 15, 1907. This patent is entitled, "a device for amplifying Feeble Electrical Currents." To quote the inventor, and referring to drawing, Fig. 3:—

"My invention relates to devices for amplifying feeble electrical currents—such, for example, as telephone-currents; and its object is to produce an amplifying device of greater efficiency and simplicity than those heretofore employed.

It will be described with reference to the drawings accompanying and forming a part of this specification, and in which—

Figure 3 represents diagrammatically the arrangement of the apparatus and circuits.

In the figure, A represents an evacuated vessel inclosing a sensitive conductiug gaseous medium maintained in a condition of molecular activity.

R is a signal-indicating device.

B B' are batteries or other sources of electrical energy.

D E are electrodes sealed within the receptacle A.

The circuit B R D E is a local receiving circuit. The circuit F is a line circuit conveying the currents to be amplified to the amplifying device. The electrode E, which may be of platinum, tantalum, carbon, or other suitable material, is heated and preferably maintained incandescent by the battery B'. The electrode D, which may be a plate of platinum or other suitable material, is placed in close proximity to the electrode E.

In Fig. 3, N S represents a magnet placed adjacent to the vessel A. The currents to be amplified may be impressed upon the circuit which includes the heated electrode or filament E—as, for example, by means of the transformer M—and the magnetic field set up by these currents reacts upon the field set up by the magnet N S, thereby causing a slight variation in the separation between the electrodes D E. I have found that the slightest variation in the separation of the hot and cold electrodes produces a large and disproportionately greater variation in the flux between said electrodes, especially if the latter are close together, and such variation in flux may be made manifest by the signal-indicating device R."

Further patents were issued on "Audion Amplifiers" to Dr. de Forest, and an interesting one is cited below, this being patent No. 995,126, dated June 13, 1911. The wiring diagram, Fig. 4, refers to this arrangement of the audion amplifier, and it is described in detail as follows:—

"This invention consists essentially in the interposition between the currents to be amplified and the signal indicating device; of a source of high frequency electrical oscillations, hereinafter more fully described, and between said source of electrical oscillations and said signal indicating device, I may interpose a circuit including an oscillation responsive device.

The drawings which accompany and form a part of this specification illustrate conventionally several arrangements of apparatus and circuits whereby the above mentioned object has been realized in practice; but it will be understood that I do not limit myself to the precise arrangements shown, inasmuch as many modifications may be made therein without departing from the principle of my invention.

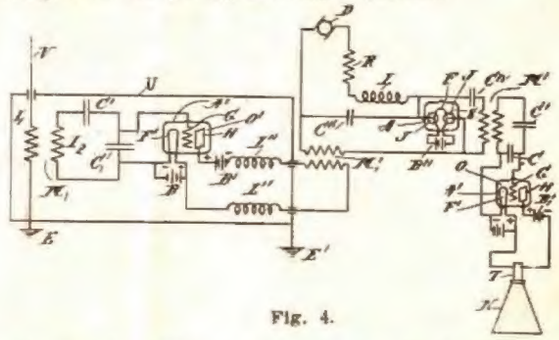


Fig. 4.

In the drawing, Figure 4 represents one form of my invention applied to a space telegraph or telephone receiving system.

In the figure, D is a source of direct current, R is a resistance, inductive or non-inductive, L represents an inductance which may be employed, C_1 C' C'' C_{IV} C_V are condensers, M M' M M_1' are transformers, B B' B'' B''' are

batteries, K is a microphone transmitter, N is a megaphone, and T is a signal-indicating device which may be a telephone receiver.

In Fig. 4, the circuit S C^{iv} M^{1}, represents a source of high frequency electrical oscillations having a spark frequency higher than the more essential frequencies accompanying speech waves and preferably higher than the limit of audibility, and as shown in the present instance said circuit is shown as a "singing-arc" circuit capable of developing practically continuous electrical oscillations when it is connected with the source of direct current D through leads of high resistance or high inductance.

In Fig. 4 I have represented the discharger for the condenser C^{iv} as consisting of two electrodes J J sealed in a receptacle A and maintained in any suitable atmosphere under small or large pressure. The filament F may be heated by the current of the Battery". It will be understood however that I do not limit myself to any special type of discharger and that any suitable source of high frequency oscillations having the characteristics above set forth may be substituted for the circuit S C^{iv} M^{1}.

O represents an oscillation detector of any suitable type and herein shown as an audion consisting of the evacuated vessel A' having sealed therein the filament F' heated by the battery B, the grid G and the plate H, the latter being connected to the positive pole of the battery B' and with the signal indicating device T. The audion O is associated in any suitable manner with the tuned circuit M C^{1} C_{1}, which in turn is associated with the source of high frequency oscillations.

In Fig. 4, V represents a receiving antenna connected to earth E through the primary I_{1} of the oscillation transformer M_{1} whose secondary I_{2} forms part of the tuned receiving circuit which includes the condensers C', C_{1}. Associated with said tuned receiving circuit in any suitable manner is the audion or other suitable oscillation detector O', the local circuit of which includes the primary of the transformer M'_{1} and if desired, the choke-coils L" L".

The telephone circuit and the local circuit of the audion O' are indicated as associated with the high frequency oscillation circuit by means of the transformers M' M'_{1}, although it will be understood that any other suitable means may be employed to associate the circuit which carries the currents to be amplified with said oscillation circuit, and furthermore that I do not limit myself to the association of the said circuits with said oscillation circuit at the particular point shown, viz., a point in the leads to said oscillation circuit. When the circuits are arranged in the manner shown in Fig. 2, the condenser C" may be employed to afford a path of low impedance for the currents developed in the transformers M', M'_{1}. Preferably, the inductive relation of the turned circuits M C^{1} C^{2} with the oscillation circuit should be maintained by a transformer of small magnetic leakage, if a transformer is employed.

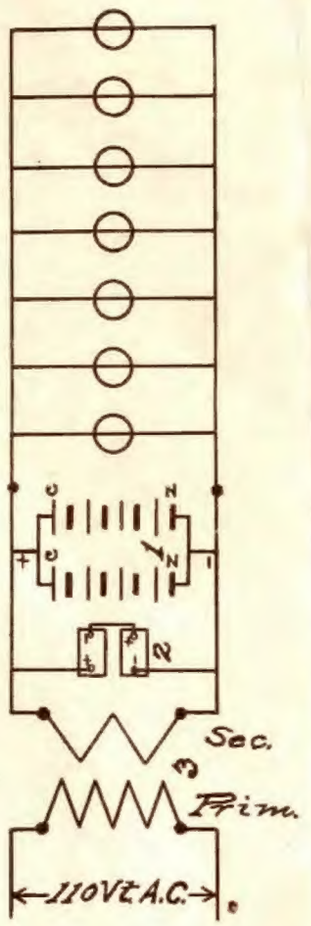
In Fig. 2, U represents a metallic case which may be grounded at E E'.

The operation is as follows: The feeble electrical currents developed in the primary of the transformer M' or M'_{1} are impressed upon the high frequency oscillation circuit, thereby varying the amplitude of the oscillations in said circuit in accordance with the sounds initiating said feeble currents. The energy of said oscillations, so varied in amplitude, is translated to the circuit M C^{1} C^{1}, attuned to the frequency of said oscillations, and actuates the oscillation responsive device O causing thereby currents in the circuit of the telephone T closely approximating in form those developed in the primary of the transformer M' or M'_{1} but greatly exceeding the latter in amplitude. It has been found that the tuned receiving circuit M C^{2} C^{2} need not be employed and also that the oscillation detector O may be omitted as shown in Fig. 3. In this case the telephone receiver T responds to variations in the amplitude of the currents developed in the line Q Q, the frequency of said currents exceeding that to which the diaphragm of said telephone responds."

XMAS TREE ILLUMINATION.

EVERY year sees an increase in the use of electricity for illuminating Xmas trees, which is much safer and cleaner if properly applied, than the old time wax candles. A few methods will be outlined here, whereby trees may be lighted at nominal cost, this being chiefly dependent upon the number of lamps used.

The common method is to connect a number of low voltage lamps in series, across a 110 volt lighting circuit. While this system is commendable on account of its low first cost, (lamps and sockets, only having to be bought), and its absence of batteries or other apparatus; it is not a method to be recommended to the average person, unless they are familiar with electricity, as there is apt to be negligence in the matter of insulation and joints, which if not properly looked after is liable to cause a short circuit and this in turn may start a fire. As an example, the writer has seen 110 volts lead through a house, over two No. 18 bell wires, (twisted together at frequent intervals), with looped joints. Needless to say any such flimsy arrangement as this is bound sooner or later to cause serious throuble and in the case just cited, it is not exaggerating it any, to say, that the display was more of a pyrotechnical nature, than a decorative one. A good safe way to light up a tree, is to use batteries and low voltage lamps connected on multiple. Dry cells are often employed for this purpose, being arranged in series-multiple as at 1 in diagram. But dry batteries at their best, can only light up the lamps for a relatively short time; the lamps then being extinguished for a while, allowing the battery to recuperate, when they may be again turned on for a short time, etc.



This is generally unsatisfactory, and at a slightly greater first cost, a much more efficient system may be had, utilizing Gordon primary batteries or the Electro storage battery. The primary batteries give but .7 volts apiece on closed circuit but have a large ampere-hour capacity, which is the feature most desirable here. Four of the above cells (100 ampere hour size), will be sufficient, using 2½ volt Tungsten lamps, connected all on multiple. Taking the lamps at about one-half candlepower and the current consumed by each lamp at one-fifth ampere, then for a circuit containing 10 lamps, the current required would be two amperes. Hence the above cells would light the lamps steady for 40-50 hours, when the cells could be recharged if desired; by a new chemical renewal.

Storage cells form an excellent source of energy for Xmas tree lights. Their first cost, for two 20 ampere hour cells is not much greater than for the Gordon cells cited above. The voltage of the two storage cells in series would be 4 volts. Using 3½ to 4 volt lamps, of about one-half candlepower and one-seventh ampere each, for a circuit of 10 lamps would require about 1.25 amperes. The above cells would light the 10 lamps for about 15 hours on one charge. It is to be noted of course, that the storage cells must be charged from some D. C. supply. Any garage will charge them at a reasonable sum. A small transformer has recently been brought out, which when connected to any 110 volt A. C. lighting circuit, transforms the voltage down to a lower value (6-14 volts) suitable for Xmas tree lighting, etc. This forms a safe and convenient means of lighting up a tree for those who have electricity in their homes.

In the diagram, 2, is shown the storage cells connected to the lamps, while, 3, indicates the use of the transformer alluded to above. To find the number of lamps to be connected in series to a 110 volt circuit, divide 110, by the voltage of each lamp; for instance, if the voltage of each lamp is 12, then $\frac{110}{12} = 9\ 1\text{-}6$. Hence 9 lamps would be connected in series across 110 volts. The number of lamps for other circuit voltage, is found in the same way.

For further detailed data on low voltage battery lighting outfits, the reader is referred to the "September" issue, also to this issue, Lesson 5, of the "Experimental Electricity Course."

[Editor:—All of the apparatus mentioned herein is listed in the new E. I. Co. catalog No. 12, just off the press, and every reader will certainly want a copy of this cyclopedic price list, which is partly a text-book on Electricity and Wireless.]

WIRELESS TRAVELS 4,000 MILES.

Wireless messages transmitted from the royal station at Laecken, Belgium, were received at Boma, in the Congo, 4,000 miles distant.

A transmitting station will be built at Boma.

Experimental Electricity Course

By S. Gernsback and H. W. Secor.

EXPERIMENTAL ELECTRICITY COURSE—LESSON NO. 5.

Small Electric Lighting Plants.

THE small electric lighting plant which is usually isolated or away from any ordinary sources of current supply, has grown to be legion nowadays, thanks to the wonderfully developed gasoline engine, and the simplification of the electrical generating apparatus. Every farmer can now have his own electric plant, and it will cost him practically nothing in most instances, especially where *water-power* or *windmills* are at hand, with which to drive a dynamo. Failing these facilities in the line of prime-movers or driving power, a *gasoline* or *kerosene internal explosive engine* is quite cheaply procured, and often to do duty for driving odd machinery around the place, and the dynamo simply absorbs power during the idle moments, to charge a storage battery floating across the line wires leading from the dynamo. In this arrangement an automatic cut-out must be inserted in the line so that whenever the dynamo voltage falls below that of the storage battery on charge, it will automatically disconnect the dynamo from the battery, otherwise the battery would discharge back through the dynamo. This cut-out is sold by the Electro-Importing Co. for $9.00.

The Beauty of Electric Lights

A typical farmhouse, or isolated electric lighting plant is illustrated by cut Fig. 1. Such a plant as this, of course, is a little above the average but does not cost over a few hundred dollars for the initial installation. The up-keep, maintenance and safety cannot be estimated in dollars and cents. A farm or dwelling equipped with such a plant or a similar one, can produce electric current at a fraction of the cost charged by the central station companies.

The principal merits of the electrical system for lighting the premises, driving small motors and machines, etc., is its comparative safety, cleanliness, and efficiency, as compared to any other scheme for accomplishing like results. For instance, the following features will serve to prove the vast superiority of the electrical system over acetylene, gas, oil, etc.

To begin with an electric incandescent lamp, such as the carbon or tungsten filament type, consumes no oxygen whatever from the atmosphere, and hence it does not devitalize the air, as is the case with any form of oil, wax or gas illuminant. An ordinary gas light consumes as much oxygen in an hour as six full grown people, and a petroleum or kerosene oil lamp consumes a much greater quantity in the same space of time.

More fires are caused by the upsetting or explosion of oil lamps annually, than by all other agencies put together, as proved by insurance statistics. So one of the great features of an electric plant, is its ability to lower the insurance rates, as it is practically the safest illuminating system known. The annual fire statistics prove this, the yellow journal reports to the contrary notwithstanding. A common cause of fire, when the origin is unknown, is of course the now familiar "crossed electric wires." The wires in the first place, are rubber covered, and rarely ever short circuit or come in contact with each other's metal sections, as the rubber is thick enough to hold the electric charge on them easily. If the wires are properly installed, and rigidly supported in place on porcelain insulating cleats or knobs, or installed in iron conduit, no trouble whatever will be experienced with the system.

There are several types of isolated electric lighting plants, some having storage batteries, and some do not. A table is here given for various lighting outfits supplied by the Electro-Importing Co. The principal plant combinations will be described in order. The somewhat elaborate plant shown in the first illustration, is made up of a gasoline or kerosene oil engine driving a dynamo. The engine and dynamo in this type of plant are usually run during the day, to charge the storage cells seen at the left of the picture. At the end of the day's charge, i. e., at evening, the dynamo is stopped and the storage battery is connected by means of the switchboard to the light wires or circuits. The lights thus take their energy from the battery all night, and the next day it is recharged again. The philosophy of this scheme is that, in most cases of private houses and the like, it is not desirable to have an engine operating during the night on account of noise, attention necessary, etc. However, a well regulated system can be run perfectly satisfactory all or a part of the night without any undue trouble or annoyance. A compact engine and dynamo mounted on a single bed-plate is shown at Fig. 2. The engine is fitted with an extra heavy fly-wheel to give a steady turning effort or torque to drive the dynamo, so that the lights will not flicker. Not every engine is suited to drive a dynamo for lighting purposes. If the speed is not sufficiently steady, then neither will the voltage of the dynamo be, and consequently the lights will flicker more or less. Heavy fly-wheels and special governing devices on the engines obviate the flickering to a great extent. If a storage battery is used

DATA ON ELECTRIC LIGHTING PLANTS.

Type of plant.	Volts with Load.	Amp.-hours capacity	No. of Tungsten Lamps, normal load.	Hours Lamps can be burned.	C.P. of each Lamp.	Source of Energy.	Charging Rate in Amperes. Cells in Series.	Length of charge in hours.	Price of Lighting Outfit complete.
1-P.	1.4	100	4 or 2	25-50	1.25 C.P.	2-100 A. H. Gordon Cells	Chem. Renew.		$5.03
2-P.	2.8	150	6 or 3	25-50	2.5 C.P.	4-150 A. H. Gordon Cells	Chem. Renew.		12.83
3-P.	3.5	300	12 or 6	25-50	3.5 C.P.	5-300 A. H. Gordon Cells	Chem. Renew.		20.23
1-S.	2.0	10	1	20	1 C.P.	1-type H. O. Stg. Cell	2	5	2.13
2-S.	4.0	10	1	10	3½ C.P.	2-type H. O. Stg. Cells	2	5	3.33
3-S.	4.0	20	2	10	3½ C.P.	2-type R. E. Stg. Cells	2.5	8	5.23
4-S.	6.0	40	5	8	6 C.P.	6-type R. E. Stg. Cells	2.5	8	12.73
5.S.	10	40	6	6.6	10 C.P.	10-type R. E. Stg. Cells	2.5	8	21.33
6-S.	6	40	4	10	6 C.P.	1-6 V. 40 A. H. Stg. Bat.	5	8	8.28
7-S.	6	60	6	10	6 C.P.	1-6 V. 60 A. H. Stg. Bat.	7.5	8	10.83
8-S.	6	120	12	10	6 C.P.	2-6 V. 60 A. H. Stg. Bats.	7.5	8	21.23
9-S.	12	120	12	10	12 C.P.	4-6 V. 60 A. H. Stg. Bats.	7.5	8	40.23
10-S.	6	60	2†	17	16 C.P.††	1-6 V. 60 A. H. Stg. Bat.	7.5	8	9.85

		Amps.		Cost of Dynamo		Mechanical H. P. required to drive dynamo	
1-D.	6 Volts	4	4	$3.70	6	Type S. No. 1331 Dynamo 1-16 H. P.	$5.73
2-D.	6 Volts	14	14	9.80	6	Type 614 Dynamo ⅛ H. P.	15.83
3-D.	10 Volts	25	25	48.50	10	Type E. E. Dynamo ¼ H. P.	65.18
4-D.	8 Volts	10	10	10.00	8	Type 810 Dynamo ⅛ H. P.	16.93

† 4 filament 16 C.P. 1.75 amp. 6 volt multiplex lamps.
†† With reflector C.P. equals 32 instead of 16 C.P.
All of the above listed outfits at the prices quoted include the maximum number of tungsten lamps cited in table; sockets; switch; source of energy, and 1 lb. No. 16 B. & S. cotton covered bell wire, suitable for connecting the lamps. For circuits over 30 feet long, No. 14 B. & S. rubber covered copper wire, Cat. No. 8006, costing $1.60 per 100 feet, should be employed, also in damp places, etc.

in conjunction with the engine, the lights will not be subject to any flickering whatever, as the current supplied by the battery is perfectly steady at all times. Slight irregularities in the speed of the engine does not matter so much in this case, as the dynamo simply forces current into the battery, much as a pump forces water into a reservoir; the battery steadying the line voltage.

The two simplest systems for lighting incandescent lamps, are those employing a dynamo and storage battery separately. The common circuit for the dynamo system appears at Fig. 3, the

	Tungsten 1-100 watts. 1.18 W. P. C.	Carbon 1-100 watts 2.97 W. P. C.	Carbon 2.48-100 watts. 2.97 W. P. C.
Candle power	84.7	33.6	83.3
Average cost lamp	$1.04	.24	.595
Average life lamp, hours	1,000	600	600
Renewal cost per 1,000 hours	$1.04	.40	.9917
Power consumed per 1,000 hours in K.W.H.	100	100	248
Cost power at 5c. K.W.H.	$5.00	5.00	12.40
Cost power at 10c. K.W.H.	$10.00	10.00	24.80
Cost of renewals and power at 5c	$6.04	5.40	13.39
Cost of renewals and power at 10c	$11.04	10.40	25.79
Comparison of light for same cost	100%	42.8%	42.8%
Per cent. saving for equal light, 5c. K.W.H.	55%	....	....
Per cent. saving for equal light, 10c. K.W.H.	57%	....	....

shunt field winding having a variable resistance in series with it, to regulate the voltage applied at the lamps; but this is not necessary in small dynamos under 1/6 H. P. In Fig. 4 is shown a storage battery circuit, the 6 cells being connected in series to give 12 volts (about 2 volts each).

In the dynamo scheme, the engine or waterwheel must be kept constantly going to drive the dynamo, as long as the lights are wanted. With the storage battery arrangement, some means of recharging the battery is necessary. Generally a dynamo is employed to fulfill this function, but in some cases the batteries are recharged at a nearby power station, owned possibly by a neighbor. The dynamo system is independent of any outside apparatus or source of electric energy, but the storage battery must have electric energy in the form of direct current to recharge it.

A few rules regarding the size of *charging dynamos* for certain size storage batteries may be of service to the isolated plant owner. The standard practice in the United States for charging and discharging lead cell storage batteries, with dilute sulphuric acid for electrolyte, is the 8 hour rate, as it is called. This rule works out as follows: If a cell has a rated normal capacity of 400 ampere hours (being the product of the amperes by the hours), then to discharge it at the standard 8 hour rate would meau that 400 divided by 8, or 50 amperes for 8 hours would be the normal rate. The recharging could be at the same rate or the equivalent for a slightly longer time.* The voltage of a freshly charged cell is about 2.4 to 2.5 volts. The usual charging voltage per cell varies from around 2 volts up to 2.6 volts, at end of charge. The dynamo voltage must be always slightly higher (about 10 per cent.) than the storage cell voltage otherwise the battery will discharge back through the dynamo, which is likely to ruin the battery. To prevent such an occurrence as this, a reverse current magnetic relay is often interposed between the battery and dynamo, so that any surge of current in the opposite direction to that delivered by the dynamo will immediately open the circuit, and protect both sets of apparatus. Fuses of proper size should always be placed in the various circuits, as they are cheaper to replace than buckled battery plates, or burned out dynamo armatures.

Fig. 1.

The *methods of wiring* up a complete plant, including storage battery, dynamo and lamps is shown diagrammatically in Figs. 5 and 6. In Fig. 5 is represented only the simplest plant, without voltmeter or ammeter to indicate the strength or quantity, of current passing into or out of the battery while charging or discharging. In Fig. 6 the diagram shows two "Electro" magnetic vane measuring instruments in the battery circuit, which (as they indicate with current in either direction) will show the voltage and amperage while the battery is being charged or discharged. The field rheostat may be No. 5,000. The usual arrangement is to connect the storage battery to a D. P. D. T. switch as shown, so that the battery can be connected up to either dynamo or load at will. The battery generally receives charging current during the day, and discharges on the lamp load at night.

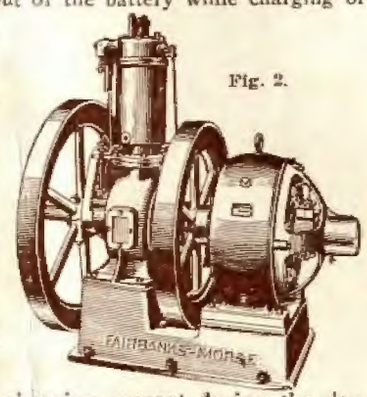


Fig. 2.

The *size of wire* to be used for any given length of circuit and load is best found from the regular formula below:

$$C.M. = \frac{\text{Length of run in feet} \times \text{amperes} \times 21.6}{\text{Volts lost in circuit.}};$$

C. M. is area of wire in circular mils, and the corresponding size of the wire is readily found from any wire table.

The volts lost in the circuit is usually taken at 2 to 3 volts for good service, on ordinary voltages of from 50 to 110 volts.

The wire should be rubber covered, single braided, if it is to be supported on cleats or knobs. If the wire is to be installed in conduit or pipe, it must be double braid, rubber covered. For anything above 10 volts, the Fire Underwriters' Rules for electric wiring must be complied with. A copy of their book can be had by addressing the Fire Underwriters' Association, in the principal cities.

Some useful data is given here relative to the size of dynamo, battery, number of lamps, load allowable, etc.:

Combined capacity of dynamo and storage battery at 4 hour rate of discharge in 16 C.P. lamp.	Number of storage cells.	Engine horse-power.	Engine speed.	Voltage of system.	*Dynamo speed	Dynamo C.P. lamps in 16 C.P. lamps.	Dynamo K.W.	Dynamo Voltage.	Storage battery capacity in 16 C.P. lamps for 8 hours.	Storage battery capacity in 16 C.P. lamps for 4 hours.	Ampere hour capacity of battery.
20	4	1½	300	8	1,800	10	.22	11	7	10	120
20	4	2	425	8	1,800	10	.22	11	7	10	120
20	4	1½	450	8	1,800	10	.22	11	7	10	120
40	9	1½	300	16	1,800	20	.50	25	15	20	120
40	9	2	500	16	1,800	20	.50	25	15	20	120
50	13	2	600	25	1,800	20	.72	36	20	25	120
85	13	3	600	25	1,800	50	1.44	36	25	35	160
105	32	3	600	57	1,800	50	1.40	80	42	55	120
160	13	5	575	25	1,500	125	3.60	36	25	35	160
180	32	5	575	57	1,500	125	3.50	80	42	55	120
325	32	10	500	57	1,500	270	6.15	65	42	55	120
600	33	20	280	57	1,100	520	11.85	65	57	80	160

* Dynamo belt driven.

Some tungsten lamp data is appended herewith, the tungsten lamp being the greatest boon to small lighting plants ever, as it consumes about 1/3 the energy for the same intensity of illumination as the carbon filament lamp.

Tungsten lamps give out a pure white light, which is very fine to read by, and the life of these lamps is as long and generally longer than that of carbon lamps. About three times the illumination can be obtained from the same size of plant with tungsten lamps as with carbon lamps, the quantity of power consumed remaining the same.

A few of the "Electro" storage cells which are suitable for electric lighting plants are illustrated in Fig. 7.

* See Lesson No. 3 on Storage Batteries for details.

Some electric lighting fittings and supplies are seen in Fig. 8, including sockets, snap switches, wall brackets with reflectors, shades, candlesticks, etc. A standard tungsten lamp is depicted at Fig. 9, the only difference between it and a carbon lamp being that the filament is composed of the metal tungsten, instead of carbon.

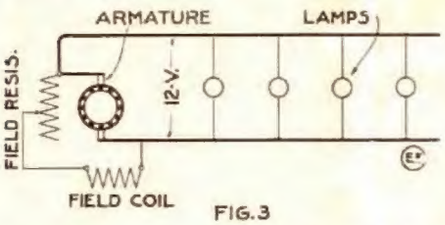


FIG. 3

A few more pretentious chandeliers, for electric lighting, are shown at Fig. 10. These are made of brass, and make a fine appearance in any house. Any style shade can be fitted to the chandeliers or drop lights, according to the tastes of the purchaser.

Isolated plants, of whatever size, usually employ a gasoline engine, steam engine, water wheel or windmill. A few rules for arranging the plant may be of use to the builder and operator.

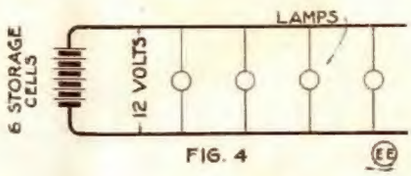


FIG. 4

The dynamo, to start with, is generally purchased ready to run, as it does not pay to build them nowadays.* The dynamo should be located in a spot free from dampness, or else thoroughly housed over by a wooden cover. If of greater capacity than ½ H. P. it should be particularly well set up and secured to a concrete foundation, or it may be fastened to a wood base built out of filled yellow pine. If not housed in, the dynamo should be provided with a tarpaulin or canvas cover to put over it when not running. The dynamo should be kept well oiled at the bearings and quite clean.

The name plate of most dynamos supply the necessary data as to their capacity, speed to be driven at, etc. The capacity is frequently given in kilowatts or horsepower. To find the number of watts this rating is equivalent to, multiply the K. W. by 1,000 or the H. P. by 746. To find the K.W. divide the product of the volts multiplied by the amperes, by 1,000; and for H. P. by 746. With a given number of watts, the volts is found by dividing the watts by the amperes; or to find the amperes, divide the total watts by the volts. The watts taken by a lamp of certain candlepower (C.P.) is ascertained from tables in catalogues or textbooks. Hence, from the above it is seen that the number of given size lamps that can be lighted by a certain size of dynamo is equivalent to the total watts capacity of the machine, divided by the total watts per lamp. A 110 volt, standard tungsten lamp consumes, 25, 40 or 60 watts, etc., at about 1.2 watts per candlepower, as compared to the carbon lamp's consumption of 3.1 to 3.5 watts per candlepower.

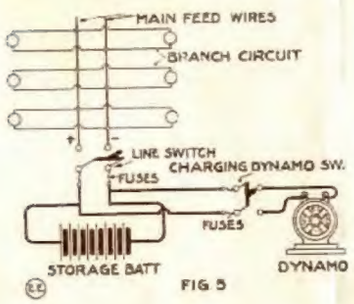


FIG. 5

The majority of small plants drive the dynamo by a leather belt running over the engine pulley and dynamo pulley. Endless belts are the best for dynamo drives, as a common laced or patent hook splice gives rise to irregularity in speed.

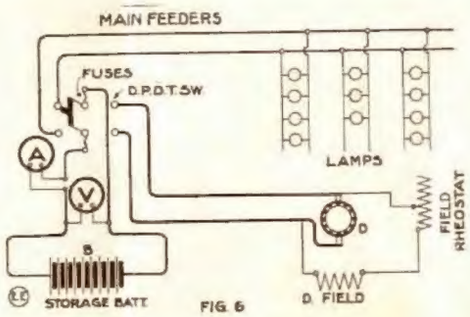


FIG. 6

The most important part of arranging the belt drive is to have the dynamo and prime-mover pulley so related, that the speed of the former is correct. The rule for finding the size of one pulley for a certain drive when the other is known, is as follows: The diameter in inches of the unknown pulley is equal to the diameter in inches of the known pulley, times its speed in revolutions per minute (R. P. M.), and this product divided by the desired speed in R. P. M. of the new or unknown pulley.

Fig. 7.

As an example, suppose that a 20-inch pulley rotates on an engine shaft at 1,500 R. P. M. and the dynamo is to be driven at 2,000 R. P. M., then what must be the diameter in inches of the dynamo pulley to insure the proper speed? Solution:

Fig. 8.

Diameter of the driving pulley (here 20 inches) times its speed (1,500 R. P. M.) equals 30,000. 30,000 divided by the dynamo speed, viz. 2,000, gives 15 inches as the diameter of the dynamo pulley. This considers that the belt transmission is perfect, but in practice it is not, and it is usual to allow an increase in the calculated dynamo speed of 2 per cent. for slippage. Every friction belt slips some, and frequently on high speeds it creates such a quantity of static or frictional electricity, that special means have to be provided to dissipate it in the ground. A grounded wire, connected to a wire comb or set of metal teeth in close proximity to the moving belt, will dissipate or carry off any static discharges to earth.

Fig. 9.

The horsepower and size of belt are very important, for anything above ½ H. P., for if the belt is not wide enough it can not successfully carry the load, and will tend to slip off the pulleys.

(Continued on Page 124)

* The E. I. Co. supply any size or voltage dynamo desired, as well as gasoline engines at attractive prices.

Modern Radio-Telegraphic Receiving Sets

By H. Winfield Secor.

THE receiving apparatus of a radio-telegraphic station to-day, should be a pretty flexible one, as regards its ability to tune in different wave lengths.

A few paragraphs will be devoted here to a modern receiving set, such as one composed of "Electro" instruments. Several hints are offered which may help the young wireless dabbler and beginner, as there are a number of

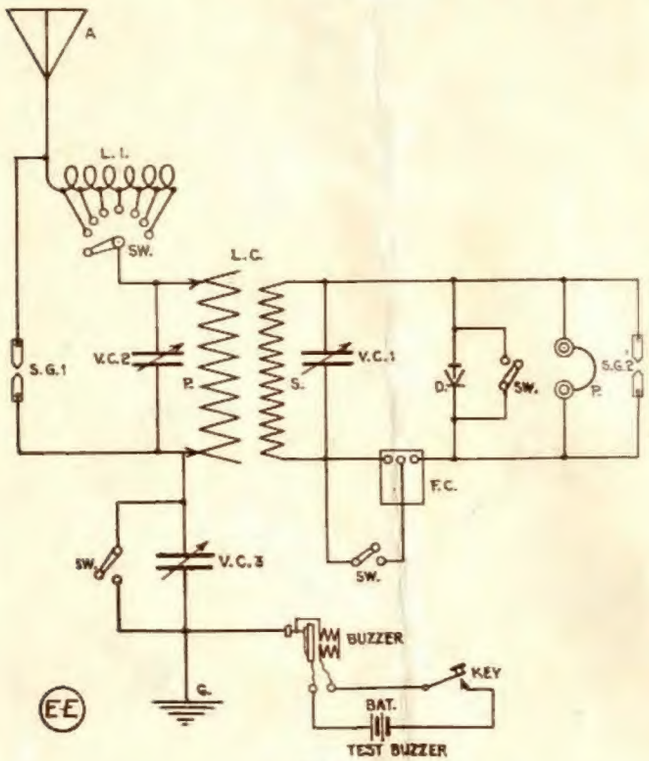


FIG. 1

small items in a receiving station, which if not properly taken care of, result in a low receiving range, etc.

To begin with, we shall look over the predominating features of such a set. Firstly it should have a long wave length capacity, of say, up to 4,000 or 5,000 meters value. The conducting path through the apparatus from antenna post to ground, should be a first class one, free from loose or microphonic contacts, and preferably of some finely stranded copper conductor, such as ordinary flexible lamp cord, No. 16 or 18 B. & S. gauge. For a good set, to give constant and satisfactory results, with the same strength of signals every day, (relatively), all wire connections which are in any way liable to jar loose, or become microphonic

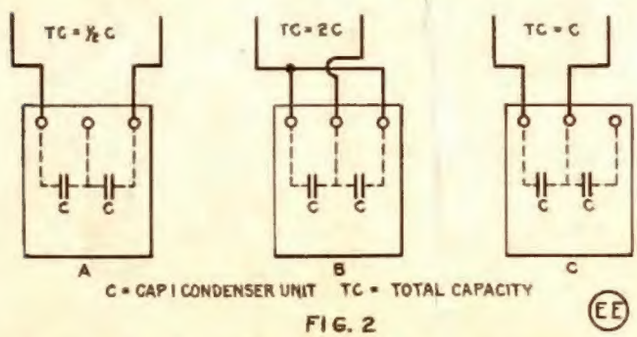


FIG. 2

in character, should be thoroughly soldered. A non-corosive resinous flux is the right one to use, such as "Solderall," supplied by the E. I. Co. All bare wire joints which are liable to come in contact with other metallic circuit connections, must be taped with some friction tape, and it is well to shellac them.

Considering the general layout of an up-to-date receiving outfit, we may refer to Fig. 1, which illustrates schematically the connections for a variety of E. I. Co. instruments. The instrnments indicated are:—L. C. a No. 12,002 loose coupler, or receiving transformer with primary and secondary coils; V. C., variable condensers such as the No. 3,500 or 9,241 style. At F. C. is placed the usual stopping condenser of the No. 10,000 type, and which consists of two units mounted in one case. Each condenser unit connected between the centre post and the outside one, has an approximate capacity of .0005 M. F. Hence to obtain a joint capacity of .001 M. F. the connections are made to the condenser as at Fig. 2, B, while when connected as in Fig. 2, C, the capacity resultant is that of one unit, viz., .0005 M. F. To obtain one-half this capacity, the two units are joined in series as per Fig. 2, A, and also Fig. 1. The right amount of capacity to use for this part of the circuit is dependent upon several functions, such as the inductance and resistance of the telephone receivers employed, the similar values of the secondary winding of the loose coupler, the characteristics of the detector used, et cetera. Hence it should be experimented with, until the maximum strength of signals are heard in the telephone receivers. The author's common arrangement for this part of the circuit is to shunt a single pole switch across one unit of the No. 10,000 fixed condenser, and when signals are coming in this switch is closed a second, to see if the strength of the signals is augmented or lowered.

Fig. 3.

Resuming our outline of the instruments involved in a typical receiving set, as diagrammed at Fig. 1, a variable condenser V. C. 1, is connected across the secondary of the loose coupler, to enable the operator to tune the detector circuit to the primary circuit. This capacity should be fairly large, and either the "Electro" No. 9,241 or better their No. 3,500 rotary type, illustrated at Fig. 4, is preferably utilized at this point. We next come to the detector unit D, and of course this is used in many different forms, such as the adjustable mineral stand, shown at Fig. 5, down to the modern Gas Valve type, the De Forest Audion. For the mineral type the writer has obtained very satisfactory results using a light spiral spring, resting gently on a newly broken-away face, of a piece of galena. This is a lead colored substance, which is very easily split up into small cubes. A new face should be used every few days, as when it becomes dull and dirty, its sensitiveness is greatly reduced. The spiral spring is easily formed of a few turns of fine copper, brass or phosphor bronze wire, wound around a nail or other mandrel about one-eighth inch in diameter. The audion detector has proven one of the most sensitive of any type ever invented. It has been adopted in practically all the best commercial and experimental radio stations today, for long distance receiving.

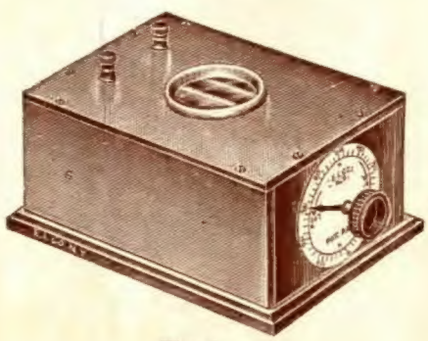


Fig. 4.

Where the receiving set is located in the same station with the transmitter, the detector is best shunted by a short-circuiting switch S2. Further protective devices against heavy static, lighting or other surges in the receiving circuits, are afforded

by the .01 to .02 inch spark gaps, placed at SG 1 and SG 2. The small protective spark gap connected across the telephone receivers is very good, and saves burning out the receiver windings by heavy static surges which occur often in tropical countries, or by a cross current from the sending set, which sometimes happens through an oversight in testing, etc.

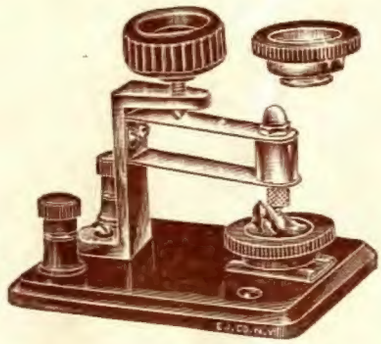
The telephone receivers and the detector may be said truly, to be the heart and brain of the radio receptor. Therefore the owner or operator of such apparatus always makes it a point to obtain the very best grade of these. The receivers utilized for wireless purposes do not differ radically from the ordinary Bell telephone receiver, but their resistance is many times greater as they have to work on a very minute current, usually ranging from 20 to 75 micro-amperes. (A micro-ampere is a millionth of an ampere.) As the magnetic effect produced in the receiver by the coils of wire wound around its pole pieces, is dependent upon the product of the amperes and the wire turns, the reason why these receivers have a very high resistance is at once apparent. It is not the resistance in ohms which produces the increased sensitivity in the 'phone; but the ampere-turns, and of course up to a certain limit, the two are more or less related. About 4,000 ohms for a pair of receivers, is generally sufficient to produce a very sensitive 'phone, providing the windings are properly balanced out, as regards the size of wire used, inside and outside diameter of coil windings, etc. The E. I. Co., supply a very efficient line of wireless receivers now, which are built in their own shops at New York City, and all the windings are carefully checked on an improved pattern Wheatstone Bridge for resistance. Also the number of turns are accurately counted automatically on an ingenious winding machine specially built for winding these small coils. Finally the best Tungsten steel magnets of the proper strength, as found from experiment, are placed in the receiver. The magnet poles are carefully spaced with respect to the iron diaphragm, and after magnetizing on a powerful electro-magnet, the receivers are tested on a radio receiving set in the Wireless Laboratory, to ascertain their sensibility. For those desiring to have a pair of specially wound high resistance receivers for research work, the E. I. Co. can wind sets having a total joint resistance for the two receivers, of 6,000 to 7,000 ohms. The usual standard resistance ascertained after several years experimenting is from 2,000 to 3,200 ohms. Practically all of the U. S. Navy sets do not run above these figures, and as is well known, they demand and get the best of everything possible, especially in radio instruments. Two styles of "Electro" wireless receivers are shown at Fig. 6.

Fig. 5.

Fig. 6.

Having discussed the principal apparatus usually employed in the secondary circuit of a radio receiving set, attention will now be diverted to the equally important primary circuit. This circuit has to be tuned to the wave length, of the incoming signal, and so as the usual primary winding of loose couplers has not sufficient inductance to accommodate this wave length, an extra inductance and also capacity, are necessary in the aerial oscillating circuit.

Firstly, this extra inductance and capacity is supplied in part by the antenna or aerial wires. The length of the flat-top, plus the length of the vertical lead-in wire for a T or inverted L type aerial, multiplied by the constant 4.5 gives quite closely, the natural or fundamental wave length period of that aerial. In a recent U. S. Navy test conducted on 12 different warships, this wave length factor was checked closely, and it averaged about 4.4 for the 12 ships. These tests included both T and inverted L type designs. In our sketch, Fig. 1, an additional inductance, LI, is indicated in series with the antenna lead wire. Also a good size variable condenser is shown connected across the primary winding of the loose coupler, which is for long wave lengths. In receiving shorter wave lengths than those corresponding to the fundamental of the antenna and a few turns of the primary winding, a variable condenser is connected in the ground lead, V. C. 3. It is provided with a short-circuiting switch to cut it out when not wanted. Some stations arrange the variable capacity V. C. 2, on a triple pole, double throw knife switch, so that it can be readily thrown across the primary winding of the loose coupler, or in series with it, as required. The writer prefers the arrangement shown in the sketch at Fig. 1, because in most cases there is no time to be wasted in switching this condenser, and the simple single pole switch here indicated, is very quickly operated.



Referring again to the loading inductance LI, a very compact and handy form of this inductance has been brought out by the E. I. Co., and this is depicted at Fig. 3. It will enable one to tune up to 4,000 and more meters wave length, when used with the usual compliment of receiving apparatus, such as the No. 12,002 loose coupler or the No. 8,486a, tuning coil seen at Fig. 7, for the detector, tuner, and fair size aerial. The last mentioned tuning coil has a wave length capacity, with 100 to 150 foot flat-top aerial of about 900 to 1,000 meters. This coil is very useful as a loading coil and for the loose coupler receiving set, two of them are used in series with the antenna lead to receive wave lengths up to 2,800 or 3,000 meters. One coil is sufficient for this wave length range, if a good variable condenser, such as the "Electro" No. 3,500 or 9,241, is shunted across the primary winding of the loose coupler, as this adds to the joint capacity of the aerial system; while connecting a condenser in series with the aerial or ground wire, reduces the total or joint capacity and consequently the wave length of the aerial oscillating circuit. The wave length period of this circuit is given mathematically by the usual formula. (For this formula see the November Electrical Experimenter, page 100; also the E. I. Co., free "Wireless

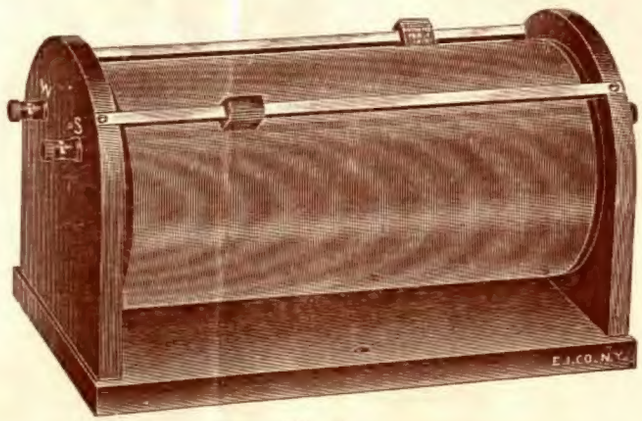


Fig. 7.

(Continued on Page 124)

WIRELESS DEPARTMENT

EFFECT OF SUNLIGHT ON RADIO WAVES.

The accepted explanation of the effect of sunlight on wireless waves is that the electric waves are absorbed in sunny weather, the absorption being favored by the "ionization" or atomic disintegration of the upper atmosphere by the ultra-violet rays of sunlight. Professor A. H. Taylor of the University of North Dakota believes he has proved that cloudy weather, by interfering with this sunlight effect, is distinctly favorable to wireless transmission. He has noted the occasions when it was unusually easy to converse with far-distant stations, and on each of these the weather map showed great areas of cloudiness between the stations or in their vicinity. Professor Taylor in an article contributed to *The Electrical World* (New York) remarks that if the ionization due to sunlight is unfavorable for wireless then "it might reasonably be expected that on a night following a day which has been sunny over a long stretch of country between any two stations the transmissivity would be low, while if cloudy conditions prevail over the same area the transmissivity would be high." And, "on the other hand, it may be argued that the ionization occurs in regions above the clouds, and that no connection between transmissivity and cloudiness should be expected." This is an interesting and important point for investigation, and, as he notes, there are few stations in this country more favorably situated for the investigation of the problem of absorption over land areas than the radio-electric station of the University of North Dakota, situated as it is in Grand Forks, just 1200 miles from each coast, and within easy reach of the lake district.

Professor Taylor goes on to say:

"It would be possible to multiply greatly these instances of the connection between cloudiness and transmissivity, as I have made many random observations after sunny days of the early winter when signals from very few stations were heard, and more often none at all. So far of some thirty observations I have found only two which do not clearly indicate that a general daytime cloudiness over a wide area is sure to be followed by an evening of high transmissivity. It still remains to be shown whether cloudiness at transmission station or at receiving station is more favorable, although I am inclined to think that the transmissivity is better when the sunny area, if there is such, affects only the receiving station and its neighborhood. The transmissivity is even then not so good, of course, as it is when the cloudy area includes both the receiving and the sending stations."

The editor of *The Electrical World* while not disputing Professor Taylor's facts or denying their importance, is inclined to think that he has not hit upon the right explanation. Ionization by sunlight he says, is almost certainly confined to high altitudes, and such conducting layers as exist below cloud-levels could hardly extend their influence over a region fifteen hundred miles wide. He has another suggestion:

"The role of high-frequency currents in the earth's crust is daily being more seriously considered in connection with the problems of radio-signalling. There is a strong probability that at great distances a very large portion of energy received by wireless is set up by free transverse earth-currents. It is known that transmission over water or damp ground is easier than over desert or other dry land. It, therefore, seems easily within the bounds of possibility that the observations of Professor Taylor might be further interpreted by considering that after a cloudy day the earth's surface retains more of the moisture deposited nightly, and so permits the passage of radiated waves and their accompanying earth-currents with smaller conduction losses. It is hoped that other investigators who have made studies of similar conditions may be prevailed upon to place their data before the radio-engineering public, through our correspondence columns or otherwise. Only by comparison of many observations is there any hope of securing sound explanations of phenomena so complicated and vast, as those involved in radio-transmission."

WIRELESS PATENTS SUIT.

Judge Buffington filed an opinion in the United States Appellate Court recently sustaining the suit of Samuel M. Kintner and Halse M. Barrett, receivers of the National Electric Signaling Company, against the Telefunken Wireless Telegraph Company, for alleged infringement of three patents involving certain methods of wireless signaling. The Court also orders the defendant company to render an accounting.

THE WIRELESS CALL.

Once more the world lays its laurel wreath on the brow of Guglielmo Marconi.

Ten years ago, every man, woman and child on the ill-fated Volturno would have perished. Ten years ago the panic stricken passengers and crew attempting to escape death by fire faced no less than certain destruction in their frail lifeboats. Ten years ago only the mystery of the missing and the charred timbers cast ashore months after to tell the tale of the sea tragedy.

To-day the S. O. S. clicks its call for help in every wireless house on the high seas. Instantly those vast uncharted stretches become electrified with life. It sparks and crackles from every masthead. The wheel is swung hard aport. The stokers—oft forgotten heroes—sweating like demons, crowd fuel into white hot furnaces. The funnels belch forth black smoke, propellers powerfully churn a great curving track in the pathless course. In the crow's nest, the keenest-eyed sailors, glass in hands, scan the distant horizon—and above all is flashed back to the unseen victims the cheering message of courage and hope: "We're coming."

And while life and death race side by side over the trackless wastes, a thousand miles away on dry land, unseeing spectators of the ocean drama are joined in sympathy. The wireless cry for help that magnetizes the seas—irresistible lodestone of civilization—is heard 'round the world, linking the nations in common bond.

"S. O. S." SAVES 54 LIVES AT SEA.

Fifty-four shipwrecked persons from the British freight steamer Templemore, which was burned at sea 800 miles east of Virginia Capes, October the 8th., were brought by the Hamburg-American steamer Arcadia to Baltimore, Md.

Twenty minutes after the fire was discovered the wireless operator, R. Emanuel, began to flash his S.-O.-S. appeals for assistance. They were heard by the Arcadia fifty-two miles away, which immediately hurried toward the doomed ship.

"It was at 11.30 p. m. Monday,'" said Capt. Jones, "that Chief Engineer Green came to me and said: 'I smell smoke.' Together we started an investigation, and it was but a short time before the fire was located amidships, near the engine room bulkhead.

"Every one on the ship was aroused to fight the flames. The fire, however, gained headway and soon the amidships section was a roaring mass of flames.

"The dynamo operating the wireless apparatus soon got out of commission as the flames ate into the vessel. The auxiliary batteries then were used, and with these the Arcadia was told of the happenings on the Templemore. The last message sent described that the Templemore was burning fiercely, and that the men were ordered to leave in the lifeboats.

"I was the last to leave the Templemore, and had with me the wireless operator. The crew filled three lifeboats. Two lifeboats were burning in the davits when the last boat left the ship.

"The bridge also had caught fire and was burning fiercely. Everything happened so fast that no one had time to get any clothes or other personal effects.

"There was a choppy sea on, and it was difficult to keep the lifeboats afloat. We took a position to the windward until the arrival of the Arcadia."

WIRELESS HELPS EXPLORERS 800 MILES AWAY IN ANTARCTIC.

The Victorian branch of the Royal Geographical Society recently dispatched a message with winter greetings to Dr. Mawson and his party, also congratulations on the fortitude with which they were facing another winter in the Antarctic, and wishing each one a safe return "to the bonnie, blithe blink o' his' ain fireside."

The reply of the members of the expedition is: "Thank the Geographical Society for its greetings. Glad to exchange ice blink for the fireside variety."

The New Zealand Government steamer conveying stores for the relief of Dr. Mawson's party on Macquarie Island reports that although the party has no stores, there is little danger of starvation, as there are ample sea elephants and natural products of the island.

Mr. Ainsworth, the meteorologist, is enthusiastic about the utility of a wireless connection in Antarctic exploration. He is able to keep in communication regularly with Adelieland, over 800 miles away, and thereby Dr. Mawson is able to control each branch of the expedition. Every detail is transmitted to the leader, whose party is posted with the news of the day.

HOW-TO-MAKE-IT DEPARTMENT

This Department will award the following monthly prizes: FIRST PRIZE $5.00; SECOND PRIZE $2.00; THIRD PRIZE $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical, and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted, a prize of $5.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $5.00.

Constructing an Oscillation Transformer

By Samuel Cohen.

Under the new Wireless Law all amateurs are prohibited from using a wave length exceeding 200 meters, and they must also radiate a pure sharp wave. This means that the primary and secondary circuits must be in tune. Since the amateur with an ordinary helix and condenser can not obtain the regular requirements of the law, therefore it is necessary for him to obtain some kind of an instrument, that will fulfill the requirements of the new law and this is fulfilled by an oscillation transformer.

The writer describes here a simple oscillation transformer which is similar to the Marconi type used on board ocean steamships.

This oscillation transformer consists of an **Electro Importing Co.'s** helix No. 8,272, and a secondary wound around it as shown in the sketch. The description in detail is as follows:

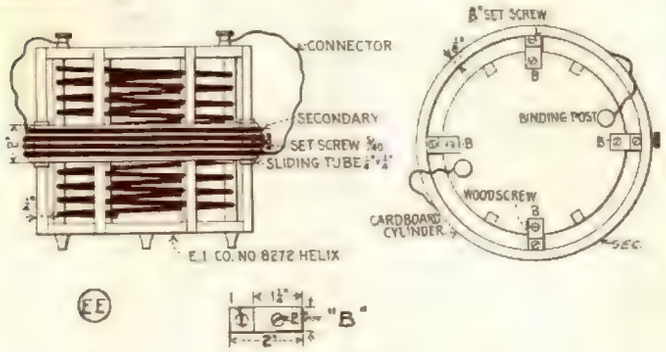


FIG. 1.

First procure two ¼ x ¼ x 10 inches, square brass rods. This can be obtained from the E. I. Co. for 20 cents a foot, and cut a No. 8-32 thread on each end of the rods. The rods are then placed on the helix, by four pieces of brass "B," for which dimensions are given in the sketch. The hole one, is a little larger than a No. 8-32 screw. The hole two, is made any desired size for a wood screw. These pieces of brass are used to support the sliding rods in place on the helix frame. On these rods, two sliding pieces of square brass tubing are fitted, and the slider rods are used to move the secondary coil up and down on.

Now procure a cylindrical ring of heavy cardboard, just as large as the diameter of the helix plus the thickness of the brass rods. It should be two inches wide, and have a wall one-eighth inch thick.

Paper strips soaked in water first, and then wound to the regular diameter, are very good. After leaving it dry, soak it again in thick shellac, and set aside until hard.

It is then wound with ordinary lamp cord or, (preferably five m/m Pirelli cable), and this lamp cord can be bought from the E. I. Co. for two cents a foot. It should bave between four and five turns. A good coat of thick shellac should be applied after finishing. The connections should be made from each end of the coil and brought to two binding posts on top of helix.

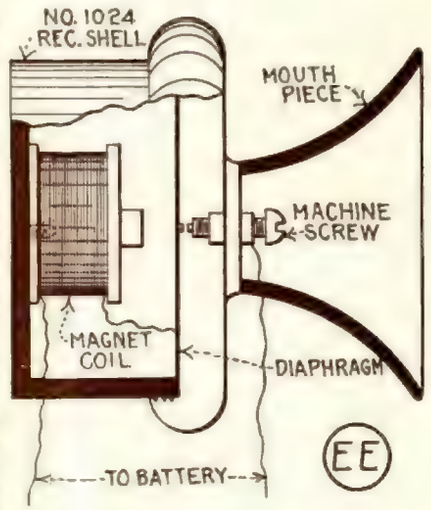
This oscillation transformer was constructed by the writer and used with one k.w. transformer without appreciable leakage. The writer has obtained all his material in constructing this oscillation transformer from the E. I. Co., and it certainly does work fine.

SECOND PRIZE $2.00.

HOW TO CONSTRUCT A SIMPLE ELECTRIC HORN.

By Percy M. Roope.

First obtain a 75 ohm receiver, such as the E. I. Co.'s No. 1,024, and remove the hanger and the spool. Rewind the spool with No. 20 or 22 insulated magnet wire. Connect one of the wires to a binding post as shown in drawing. Scrape off the insulation from one side of the diaphragm and solder the other coil terminal to it. On the front side of the diaphragm, a small place should be scraped in the center of it. Next procure a transmitter mouth-piece, (as E. I. Co.'s No. 6,082), and fasten it to the receiver cover with hot sealing wax. Through one of the holes in the mouth-piece put a small machine screw. Bore a small hole in the side of the mouth-piece. A short piece of wire should then be connected between the binding post of the receiver and the machine contact screw. This should be done by passing the wire through the hole in the receiver that was used for the head band, and the hole in the mouth-piece. The pitch of the horn may be adjusted by means of the machine screw.

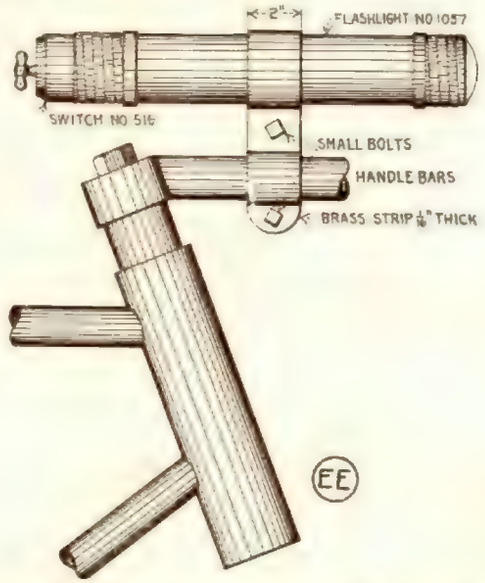


This horn can be used in place of an electric bell or buzzer and in any place where a loud noise is required. The larger the horn, the more sound it will give. The contact screw and the point on the diaphragm opposite it, should be silver faced, or E. I. Co., platinum points No. 6,936, may be employed to good advantage and are strongly recommended. The steel magnet of course is not required and is removed from the receiver.

AN IMPROVED BICYCLE LIGHT.

By Thomas W. Benson.

By fastening an "Electro" No. 516 miniature snap switch, on the butt of a No. 1,057 tubular flash light, by means of a small metal clamp made as shown, I recently fitted a handy and efficient head-light to my bicycle.



As the switch is within easy reach, quite a long life will be obtained for the dry battery, if the light is turned off for short stops, etc.

Now is the time to get that binder to preserve the monthly copies of The Electrical Experimenter. A fine cloth binder, with patent filing device, and holding 12 numbers, supplied at $1.00 prepaid.

HOW TO MAKE A NOVEL WIRELESS RECORDER.

By Albert E. Shaw.

There are at present many amateurs who are tempted to give up wireless experimenting, because they cannot read or take down the rapid signals. Herewith, is a description of a novel wireless recorder, made as follows.

First obtain an "Electro" New Departure Motor No. 1,271, and remove the pulley, and in its place put a wooden pulley as shown at Fig. 1. Then mount the motor on a base 6 x 4 x ½ inches.

The key, which copies the messages, is mounted at the centre of the base, as shown at Fig. 2. It can be the E. I. Co. No. 1,118 style.

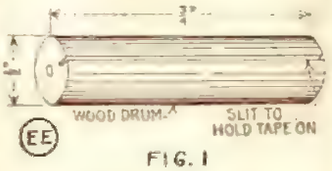


FIG. 1

Before mounting the key lever, procure a piece of soft graphite from a lead pencil and drill out the top contact point of the key, twice as large as the diameter of the graphite, so as to fasten the lead in with some "Electro" Hugonium Alloy No. 7,778. To drill the hole use "Electro" drill No. 6,162. In place of the lever contact, fasten a strip of blotting paper underneath the lead, for the paper to run or slide along on.

For the tape supply reel P, you may use an ordinary tin spool, such as enamelled wire comes on.

The tape used in this instrument is "Electro" tape No. 5,786, and the spool two, is mounted as shown at Fig. 2, B. The recorder is now finished, except for a few batteries to run the motor, and they may be "Electro" No. 1,001 or Columbia No. 990.

In operating this recorder, first start the motor, and put the wireless receivers on your ear, which come from detec-

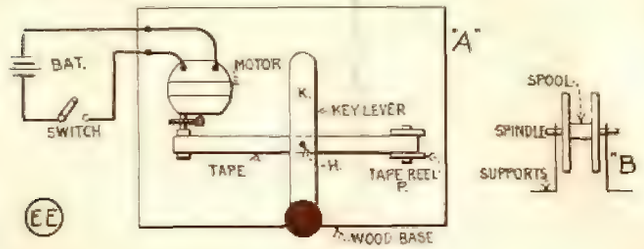


Fig. 2.

tor, tuning coil, etc. For example, you hear in the receivers; dot, dash, dash, dot; you repeat the same thing on the recorder, as fast as you can receive them with the key, and the paper moving past it will record just exactly what you send on the key. With a little practise, you will be able to take messages at from 15 to 30 words a minute easily.

EXPERIMENTAL ELECTRICITY COURSE.

(Continued from Page 119)

The required width of leather belt for any horsepower is given by the following formula:

$$W = \frac{1925 \times H}{D \times N};$$

Also, $$W_s = \frac{2{,}750 \times H}{D \times N};$$

Where: W is the width in inches of a suitable double leather belt.
1,925 is a constant.
H is the horsepower to be transmitted.
D is diameter in inches of larger pulley.
N is the revolutions per minute of larger pulley.
W_s is the width in inches of a single leather belt.

The distance between the centres of two pulleys connected mechanically by a belt, should not be less than 3 to 4 times the diameter of the larger pulley. Horizontal drives are always preferable to vertical drives, as the tension on vertical systems has to be raised to a high degree to keep the slippage down. The ideal drive is a well spaced horizontal one, with the loose running side of the belt on top. For short belt drives, where it is not possible to space the individual pulleys at least twice the diameter of the larger pulley apart, then recourse may be had to the idler pulley, as it is called. An idler pulley drive is illustrated in Fig. 11, the position of the idler pulley being plainly indicated. Its function is to increase the area of pulley face covered by the belt, or the arc of belt contact.

Where the speed of the prime-mover permits, the modern method is to direct connect the dynamo, by a metal coupling, to the engine or water-wheel shaft. This is the most efficient method, as some power, even though but 10 per cent., is lost in the belt transmission. Every large up-to-date central station in the country to-day employs the direct connected unit system, i. e., dynamos directly coupled to engines.

Fig. 10

Where water power is available, it behooves the intending plant builder to look it over, and if possible harness it up to a water wheel or turbine. Water power costs nothing in most instances, and the efficiency of the water turbine is very high, being somewhere at about 80 per cent. for medium size and head of water. The pressure in pounds per square inch of any head of water is found by multiplying the heads in feet by .433; (.433 lb per sq. in. per 1 foot of head).

Windmills are applicable to dynamo drives, but must be specially equipped with automatic cut-outs in the storage battery circuit, so that if the mill slows down to a certain degree, which also lowers the charging dynamo voltage, the dynamo will be cut off from the battery. When the mill has again picked up sufficient speed, and the charging dynamo voltage is greater than the battery E. M. F. then the automatic switch closes its circuit with the battery again, etc. Another automatic cut-out is arranged to cut out the dynamo, when the battery has received full charge.

The dynamo itself, if not given proper attention, gives trouble once in a while, and the following are some of the points to be watched in operating it:

The commutator is the most difficult part of the dynamo to keep in good condition. The cleaner and freer from oil and grease it is kept, the more satisfactory its service.

(To be Continued.)

MODERN RADIO-TELEGRAPHIC RECEIVING SETS.

(Continued from Page 121)

Course," Lessons Nos. 8 and 14). The variable condenser placed in the ground lead may be the E. I. Co., No. 9,240 or 9,241, preferably the latter. A short-circuiting switch is generally connected across ordinary loading inductances, but the improved "Electro" form of this coil is so arranged, that when the switch lever is turned to the "out" or "off" position, marked zero on the dial, the coil winding is short-circuited or cut out of the circuit entirely. This loading inductance has been very exactly tested and designed, and the total ohmic resistance offered by it, when using the whole six steps of inductance, equivalent to approximately 4,000 meters, is only 13.5 ohms, which is lower than that of any other like coil on the market. The rotary movement of the switch is very important and should not be overlooked, as there is no time to be lost in tuning in a station, especially the Radio Time Signals, sent out by the Government Station at Radio, Va., or the Key West, Fla., and New Orleans stations, as well as Mare Island, Cal., for the Pacific Coast.

AMONG THE AMATEURS

CHRISTIAN BROS. COLLEGE WIRELESS PLANT.

One of the largest and most complete amateur wireless telegraph stations in the South is being completed on top of the Christian Brothers college, at Memphis, Tenn.

Instruments capable of receiving messages from a distance of 3,000 miles and for sending a distance of 1,000 miles have been installed.

The aerial room is on top of the college. It is large and roomy, constructed almost entirely of glass. The antenna is about 100 feet high and works perfectly.

Messages from Cape Cod, Panama and Atlantic coast points have been picked up and the clocks used in the college rooms are being set by time flashed to Memphis from Washington's wireless station. Weather reports are also received at the college and messages are frequently exchanged between Christian Brothers college in St. Louis and Memphis.

The station was constructed by students of the college under directions furnished by an expert, who informed the faculty that when everything needed at the station has been placed in position it will be strong enough to receive messages from the middle of the Atlantic, far out on the Pacific and all points on the Gulf of Mexico.

The station will be in perfect working order not later than Dec. 1, when messages will be received and sent regularly. Telegrams of public interest can be intercepted by any wireless stations, but these messages sent by the government or by individuals and considered personal, cannot be repeated from any wireless station unless the operator desires to subject himself to a government fine.

STONEHAM PUPILS BUILD RADIO PLANT.

A wireless telegraphy station, constructed and installed entirely by teachers and pupils of the Stoneham, Mass., high school, has been put in working order in the physics laboratory. It is expected to receive messages from a distance of 25 miles, including the naval stations in New England and the Marconi stations on the cape.

A Stoneham radio association has been formed with Stuart B. Ward as president and Russell Colley as vice-president. The faculty supervision is coming from W. F. Brackett, head of the manual training department.

Thomas Spencer and Arthur Swisher, of South Camden, N. J., are working on the new wireless telegraph station being erected by the Government at Tuckerton, N. J.

NEW WIRELESS CLUB ORGANIZED.

The wireless club of the Y. M. C. A. at Racine, Wis., adopted a constitution at a recent meeting, and made all the rules for admission into the club. A strict government wireless test must be passed before any applicant can become a member. The apparatus of the club is being put up by the boys, and in a short time they will be in communication with many important wireless stations. The club is divided into two grades, composed of the boys proficient in the profession and those who are not. Both classes are about evenly divided so that every backward member will be especially tutored. Meetings will be held every week in a special room set aside for the club.

ITHACA BOYS TAKE UP WIRELESS TELEGRAPHY.

Emulating the example of Norman Snyder of University avenue, Ithaca, N. Y., who has gained state-wide fame in wireless telegraphy, four other boys have taken up the study.

Robert Cushman, 14, son of Blin S. Cushman of West Hill, has had a station in operation about a week. Nearly every part of the station has been constructed by himself. He has received messages from Arlington, D. C.

Perkins Coville, son of Dr. Luzerne Coville of East Buffalo street, also has a station and has been able to receive messages from as far distant as Sayville, L. I. His instruments are home made.

Thomas Ladd, who lives at Buffalo and Parker streets, has a station and is able to communicate with Sayville. The two Buffalo street stations hold nightly conversations. The operators are somewhat handicapped by the telephone and electric light wires that are in close proximity. Millard Hulburt also has a station but it is not in operation. His sending set is considered the best in this part of the State.

Alfred Carver of No. 4 Warring avenue, Buffalo, N. Y., has a wireless telegraph apparatus on the roof of his house and receives messages from all parts of the country.

SALEM WIRELESS CLUB FORMED.

A wireless club has been formed at the Salem, Mass., high school. Sixteen of the pupils have joined.

WILL FORM A LOCAL WIRELESS ASSOCIATION.

Charles Walcott of New York, a member of the Wireless Association of America is in Worcester, Mass., assisting local and Worcester county wireless enthusiasts, in organizing a branch of the association.

Thomas A. Cummins of Shrewsbury, Harris Drew, assistant superintendent of the Anco mills of Wilkinsonville; William H. Allison of the local exchange of the New England telephone and telegraph company and Frank Moore, electrician in the Worcester market, will meet Mr. Walcott, in the home of William B. Smith, 88 Jaques avenue, very shortly, to make plans for the organization.

The Wireless Association of America has a membership all over the United States and Canada, and the majority of the United States wireless operators are among the members.

Farris F. Stevens, of Coleman, Texas, writes the Electro Importing Co., as follows: Gentlemen:—I received the order No. 06994 which I ordered from you in Mr. B. C. Howell's name of this city. Refer to your file No. G-7-5M. I sent for your catalog some few weeks ago, and I want to say that I am well satisfied with the order just received. Everything is neat and nice, and more than worth the money. Especially the two telimphones, listed on page 140, Catalog No. 9204a. I am going to send you another order real soon, as I find your stuff exactly as represented in your catalog.

Raymond Sprague, of Glen Cove, L. I., N. Y., an "Electro" customer states that his recent order was received in excellent condition, and that their impregnating wax for spark coils, is the very best yet, having a very high insulating value.

H. A. Conway, Eighth avenue, Rockaway Park, N. Y., writes us:

"I wish to inform you that one of the E. I. Co. **one-inch spark coils recently worked 90 miles** off the coast of Cuba. The conditions were:—Weather warm, and lots of fog and rain.

[That's going some for a one-inch spark coil, in that part of the world, where the operating conditions for radio sets are very bad. Several years ago, Mr. Charles D. Herrold, of San Jose, Cal., succeeded in transmitting 90 miles in daylight, over land and water to a Government station with an "Electro" one-inch coil, and several oaths were taken on this performance, by the U. S. Radio operators at Mare Island Navy Yard, etc. The coil was operated on a six-volt storage battery, with no secondary condenser. Shortly after this another California radio enthusiast claimed to have covered a distance of 120 miles with a one-half inch spark coil of the E. I. Co. make.—Ed.]

B. Ritchie, of Cleveland, Ohio, an E. I. Co. patron, writes them:—Some time ago I received your goods. My wireless station is composed of nearly all your goods and I owe many thanks to you for same. It certainly is an up-to-date station with your instruments. I receive all the boat stations on the Great Lakes, with your instruments. I also have a three party telephone, consisting of your "Telimphones." These phones cannot be beaten. I do not see how you can put them out at such a low price. I certainly recommend your goods to all of my friends.—"An Everlasting Customer."

A satisfied E. I. Co., customer, Leon H. Perron, of 485 State street, Springfield, Mass., writes as follows:

"I received the Telimphones O. K. and they are as represented. I have delayed in answering because I wished to give them a good test. They rang fine with six batteries at each end of my 675 foot line. The bells can be heard all over the house."

Harold Sanders, No. 521 Forty-ninth street, Brooklyn, N. Y. a Boy Scout in the Second Naval battalion of Brooklyn, will start a school of wireless telegraphy and signaling for the Scouts of the battalion. Scout Sanders is 16 years old and a licensed amateur operator.

NOTICE.

What ideas have you regarding the construction and operation of wireless and electrical apparatus? Why not write up these ideas and experiments for the benefit of the ELECTRICAL EXPERIMENTER readers and thus help yourself and your fellow worker at the same time. We are pleased to receive contributions of the above character with plain ordinary sketches or photographs, and will pay regular rates for all such matter published in these columns.

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. **At least one of the questions must deal with "E. I. Co." apparatus or instruments, or "E. I. Co." merchandise.**
2. **Only three questions can be submitted to be answered.**
3. **Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.**
4. **Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this Department cannot be answered by mail.**

STORAGE BATTERIES.

(81.) Mr. Alvin Slusser, Kansas City, Mo., writes the Query Department:—

Q. 1. How can I treat sulphated storage cells of the E. I. Co. make, and caused by too rapid discharging?

A. 1. We give you herewith directions for treating sulphated storage cells:

For sulphation, charge the battery as rapidly as it is possible to send current into it without overheating. The resistance being greatly increased by the effect of the sulphate, the cell will become hot when charging. Use a thermometer to test the temperature, and maintain the current at such a value that the temperature of the cell does not exceed 110 degrees F. Continue this charge until the plates begin to gas freely, then reduce the rate of charge to the 8-hour rate, and continue this until the plates again begin giving off gas. The rate of charge should then be reduced to half the 8-hour rate, and continued until further gasing again occurs. The cell should then be partly discharged and the treatment repeated. This cycle of operation may have to be carried on for some time, but should be continued until the negative plates show at least 0.10 volts between a cadmium electrode and the negative plate, the cadmium being positive to the negative.

Q. 2. What is the advantage of a synchronous over a non-synchronous rotary spark gap?

A. 2. A synchronous rotary spark gap has the advantage over a non-synchronous gap, in that the discharges or sparks occurring in the former, occur at regular intervals, once the gap has been properly adjusted; and conjointly, these sparks occur at the same time in each cycle of the alternating current, exciting the transformer, which is very important.

Q. 3. Having a small shunt motor with fixed brushes, and non-adjustable field resistance, how can I raise the speed of the armature?

A. 3. Considering a small electric motor you have with fixed brushes, and no variation of field current to be allowed, the speed of same may readily be varied, by simply placing a piece of iron bar across the pole shoes on the machine.

WATER MOTORS.

(82.) A. S. Burleigh, Great Falls, Mont., writes us:

Q. 1. Will the "Electro" 6" Hercules Water Motor develop sufficient power on a one-half inch pipe water main, at thirty pound water pressure to drive their type "S" six volt, four ampere, dynamo at full capacity?

A. 1. In reply to your query above, would advise that their six inch water motor will develop sufficient power on thirty pounds hydrostatic pressure from one-half inch pipe; to drive the type "S" dynamo at full capacity. They do not supply any shaft connector for these machines as you suggest; but you can easily have same made in your home city, or it could be made from a round piece of hard wood, with a couple of holes of the proper size drilled in both ends.

Q. 2. Does the E. I. Co. furnish any speed governor for this combination direct driven, hydro-electric plant?

A. 2. They do not furnish any special speed governors for such an outfit; but you could easily arrange one yourself on the principle of the common phonographic Ball governor.

RECEIVING STATION QUERIES.

(83.) E. Nettleton, San Antonio, Texas, writes the Question Department as follows:

Q. 1. I have a small R. O. 50A, E. I. Co., receiving set and want to know what additional instruments are required to increase the wave length and receiving range of this set, so as to be able to receive the New Orleans station daily?

A. 1. In answer to this query would say that with the apparatus you have we believe the addition of a good variable condenser, such as the E. I. Co. No. 3,500; a loose coupler; a No. 10,000 fixed condenser and a pair of their best grade 2,000 or 3,200 ohm telephone receivers will enable you to hear the New Orleans station sending news reports during the day.

Q. 2. Does it make a difference where the lead-in wire is taken off on the aerial?

A. 2. The aerial lead-in may he taken from the center or from either end; but it is not advisable to tap same off in between these points, as the capacity is not balanced so well, in such a case.

Q. 3. How about using the "Electro" No. 12,002 loose coupler for long wave lengths, of say 2,000 or more metres value?

A. 3. In regard to the "Electro" No. 12,002 loose coupler for receiving long wave lengths, such as 2,000 metres, etc., would advise that a couple of their loading coils costing $2.50 each, may be connected in series in the aerial lead, or also a large variable condenser, such as their No. 3,500 condenser, connected across the secondary winding of the coupler will give a high wave length capacity. In this case, a good size variable capacity should be connected across the primary of the coupler also; so that the primary and secondary circuits may be attuned properly.

40 VOLT DYNAMO.

(84.) James Tillery, Dublin, Ga., asks us:

Q. 1. Can I procure second-hand low voltage dynamos from the E. I. Co.?

A. 1. They have no second-hand low voltage dynamos on hand, but are pleased to quote you a net price of $55.00 on a 400 watt, 40 volt, 10 ampere, D. C. dynamo, operating at a speed of 2,500 R. P. M. and requiring about two weeks to build, f. o. b., New York City; the machine to be of the highest grade of workmanship throughout and fully guaranteed in every respect. The prices given, including driving pulley, field rheostat, etc.

Q. 2. Where can I procure a good storage battery?

A. 2. In regard to 6 volt storage batteries, would say that we believe you will find the "Electro" battery, listed in their catalogue No. 12, fully satisfactory for your purposes, and also that the price of these cells are very low considering their high quality.

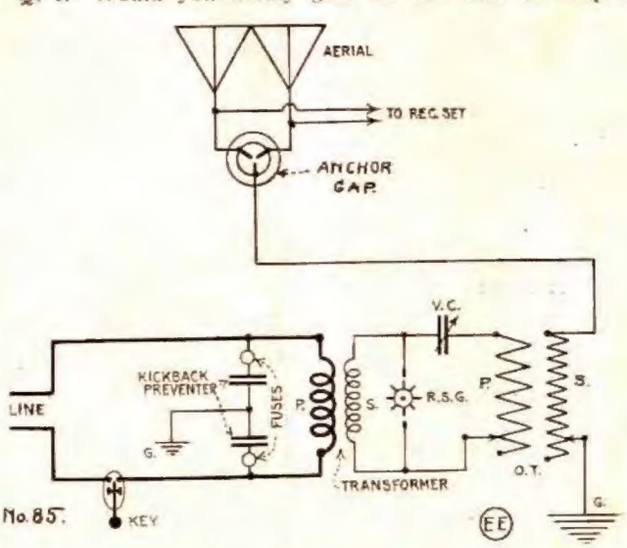
Q. 3. How about price on switchboard for controlling this complete apparatus?

A. 3. Regarding switchboard for the operation of this apparatus would say that this should contain two, 50 ampere knife switches, a voltmeter, an ammeter, and an automatic magnetic cut-out to prevent the storage battery from discharging back through the dynamo, when the voltage of same falls below that of the storage battery, which it is charging, and they can supply these apparatus at the following prices:—Voltmeter reading 0-60 volts with two and one-half volt scale divisions at $10.50 net. Ammeter reading 0-25 amperes at $10.00 net. Automatic magnetic cut-out wound for 40 volts $15.00 net. If you desire to have these instruments mounted on a slate switchboard two feet by one foot by one inch thick, they will supply this slate and mount the instruments at $10.00 additional.

WIRELESS HOOK-UP.

(85.) L. Wunderlach, West Hoboken, N. J., writes:

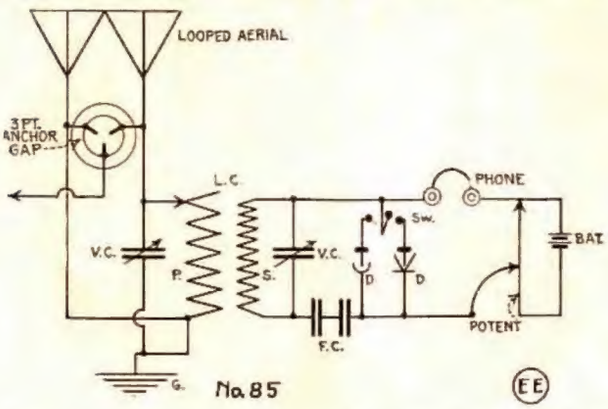
Q. 1. Would you kindly give me the best hook-up for



the following instruments: Looped aerial, Blitzen receiving transformer, two E. I. Co. variable condensers, E. I. Co. com-

mercial detectors, E. I. Co. electrolytic detector and circular potentiometer, Mesco fixed condenser and E. I. Co. Government phones.

Sending Set:—Thordarson one-half k.w. transformer, E.



I. Co. adjustable plate glass condenser, E. I. Co. oscillation transformer, rotary spark gap, three-point circular anchor gap, E. I. Co. kick-back preventer and their heavy wireless key.

A. 1. We give you below diagram for these instruments and their connections.

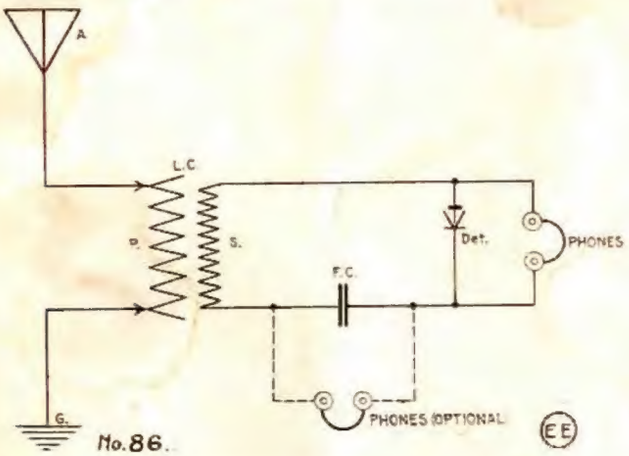
LEARNING THE RADIO CODES.

(86.) G. K. A., Elizabeth, N. J., writes:

Q. 1. Kindly give a hook-up for the following instruments: One loose coupler, one fixed condenser, one universal detector, 2,000 ohm head set, all E. I. Co. make?

A. 1. Diagram is given herewith for your apparatus.

Q. 2. What way, do you think would be the best, for an amateur to learn the codes? I mean an amateur who can pick up messages every now and then, but cannot read them because he does not understand the code. I have studied the codes, and know every letter of the alphabet, i. e., I know that A is a dot-dash and S is three dots; but somehow, I cannot pick up messages; that is, read them. Could you kindly help me out?



A. 2. You can obtain proficiency in wireless or regular telegraphy receiving, by means of the Omnigraph automatic sending machine, sold by the E. I. Co. at a nominal cost. It is a great boon to the amateur radio operator.

VARIABLE CONDENSER CONNECTIONS.

(87.) G. H. Jones, Carnvarvonshire, North Wales, England, writes the Electrical Experimenter:

Q. 1. Do the E. I. Co. supply their variable receiving condensers with a D.P.D.T. switch attached, so that the condenser can be readily connected in series or parallel with a loose coupler?

A. 1. In regard to a D.P.D.T. knife switch to reverse the connections of the variable condenser in tuning for short and long waves, would say that they do not supply their condenser with the switch attached; but it is very easily connected to the condenser.

Q. 2. What are the three binding posts on their No. 10,000 fixed condenser used for?

A. 2. The No. 10,000 fixed condensers are supplied with three binding posts or terminals, and two individual condensers are connected to the centre post and the outside posts; so that several combinations of capacity are readily obtainable. It is usual to experiment with these condensers while receiving, to ascertain the proper capacity for your particular set.

RADIO LICENSE.

(88.) E. Gellespie, Portland, Conn., asks:

Q. 1. I recently purchased a small Electro receiving set and am using same with a four wire aerial, 15 feet long, wires one foot apart and elevated 30 feet above the ground. I cannot receive any radio signals. What would you suggest as the trouble?

A. 1. In reply to this question, would say that we believe your aerial at present is entirely too small, as most of the experimental aerials about the country have a length of at least 60 feet to 75 feet in most cases; and an altitude or height above the ground of from 50 feet to 75 feet. Four to six strands are usual, spaced two feet to three feet apart.

Q. 2. I would like to procure a license for my radio receiving station, with whom should I take this matter up?

A. 2. You do not require a radio license for a receiving station only.

SMALL LIGHTING PLANT.

(89.) F. Lindeman, Beaver Falls, Pa., writes as follows:

Q. 1. I am interested in a small 15-30 light dynamo and battery outfit. Can you give me E. I. Co. quotations on such a plant?

A. 1. They do not know from your letter, just how big a generator you will require, as you do not state definitely the size of the lights you intend using. If you wish a small size generator of about 150 watts or about one-fifth horsepower giving 8 volts and 19 amperes at 2,200 R. P. M. with a lighting capacity of 19-8 candlepower 8 volt tungsten lamps they can supply it at $29.00 net. This generator can be used with a couple of their No. 555 6 volt, 60 A. H. storage batteries, and it is capable of recharging these batteries in eight hours easily, connecting the two batteries on parallel in this case. We refer you to the September "Electrical Experimenter" for tabulated data, and prices on lighting outfits; also to the lesson on "Isolated Electric Lighting Plants," appearing in this issue.

HIGH FREQUENCY COIL.

(90.) H. J. Lipham, U. S. S. Yankton, N. Y., asks us:

Q. 1. Can you supply any data for constructing a larger size high frequency coil to work on 110 volts, D. C. similar to that described in the June issue of "The Electrical Experimenter?"

A. 1. In regard to a larger size high frequency outfit of the Rosenthal type, such as described in the June issue of "The Electrical Experimenter," would say from some experiments conducted by the editor, it seems evident that you will have to try this out for yourself, as it seems quite difficult, to determine just what size the various parts of the circuit shall assume to produce a larger output. Of course this outfit is commercially built to give as long a high frequency spark as 12 inches; but this outfit is used practically altogether, however, for demonstrations or Electro-medical work, and is not of any distinct value for wireless transmitting purposes, as its voltage is entirely too high. In general it may be said, however, that the size and number of turns of wire in the "Oudin" coil, of this outfit, practically determines the voltage and length of the high frequency spark. This is dependent also to some extent, upon the size of the condenser in the oscillating circuit, and upon the size and arrangement of the "Oudin" primary winding, etc., et cetera.

THE "RADIOBUG."

"Wireless" has become an obsolete word in the United States navy. "Radio" has supplanted it. Messages are called "radiograms" and "wireless telegraphy" has been changed to "radiocommunication," spelled as one word. That is an example of building up a word German fashion. There is a tendency to call the operator "radioman" instead of "radio operator," as at present.

(Therefore the man or boy who has the wireless "bug" will henceforth please call himself "Radiobug"!!—"Fips.")

Wireless telegraphy now connects the six state capitals of Australia and will soon girdle the continent.

The E. I. Co. have so much confidence in their goods, that they have recently adopted a novel plan to convince even the most skeptical. The Company now sends out orders, provided the amount is above $5.00, without a cent deposit, no advance payment being required, for shipments east of the Mississippi River; $1.00 deposit being required of customers west of this. If the goods suit him, he pays for them, if they do not come up to expectation he returns the goods, *at the Company's expense.*

THE E. I. Co NEWS

VOL. LXII. No. 18677 ★★★ NEW YORK, MONDAY, DECEMBER 1ST, 1913 5 CENTS PER NO.

COMPLETE LINE OF SMALL LIGHTING PLANTS

Lights Houses, Bungalows, Camps

Automobiles, Launches, Etc.

(Radiogram to the E. I. Co. NEWS.)

NEW YORK, DEC. 1st. - " "More Light" is the cry of the Pee-ple. "Cheaper Electric Light" is the new Motto of the "E. I. Co." Your correspondent has been completely "enlighted" in perusing the new 1914 catalog of this firm and your readers will be "delighted" bringing them this fact "to light."

THE ELECTRO IMPORTING CO.
236 Fulton Street, New York

"EVERYTHING FOR THE EXPERIMENTER."
Retail Store, 69 W. Broadway N. Y.

Some new features of our 1914 Catalogue. "The Most Complete Electrical Experimental Catalogue in the World."

ELECTRO LIGHTING PLANTS

A complete Hydro-Electric Plant, similar to the large plants in use throughout the United States and abroad. A perfectly built and self-contained unit, mounted rigidly on common iron bed-plate. The dynamo is very powerful and develops 25 volts and 3½ amperes on 90 lb. water pressure from an ordinary ¾" faucet. On 70 lb. pressure, the output is 20 volts and 3 amperes, etc. At full capacity the dynamo will light 9 to 10, 8 C.P. tungsten lamps. The water motor is strongly built, and the dynamo is supplied shunt wound, suitable for re-

No. 1 Outfit.

charging storage batteries. The shipping weight of the outfit boxed is 34½ lbs.

No. 1 Hydro-Electric Plant, complete. Price $16.00

Dwelling

ELECTRO IMPORTING COMPANY,
236 Fulton Street, New York City.

I enclose herewith 3c. in stamps for which please send me your new 212 page electric cyclopedia for 1914 number 12, containing 450 illustrations and over 1600 articles and valuable information on Electricity and Wireless. Book also contains 20 free coupons for your 100 page wireless course in twenty lessons.

Name.....

Address .....

State .....

No. 3. Complete Lighting Outfit

The same plant as No. 2 but with 2 No. 555 batteries giving twice the above candle power for 8 hours, or the same C. P. for twice the above time in hours.

No. 3 Outfit complete, $78.00

No. 4. COMPLETE ELECTRIC LIGHTING OUTFIT.

For those having motive power at hand, such as in motor boats, automobiles, and the like the following outfit will be sufficient and very adaptable.

Outfit consisting of above No. 4620 generator, No. 4630 automatic cut-out, one No. 555 storage battery and 12 ft. 1 in. leather belting.

No. 4 Complete Outfit as described. Price..... $46.00

No. 4640.

List of Electric Lighting Supplies

We list below the more common electric lighting supplies which we stock. These goods are of the best quality in every case and we guarantee full satisfaction.

No. 8002 Cotton covered New Code Lamp Cord No. 18 B. & S. Gauge Price per ft. $0.01½

No. 8005 Cotton covered New Code Lamp Cord No. 16 B. & S. Price per ft., $0.02

No. 8006 Single braid Weatherproof Rubber Covered No. 14 B. & S. wire. Price per 100 ft. $1.60

No. 8007 Double braid Weatherproof Rubber Covered No. 12 B. & S. wire. Price per 100 ft., $2.50

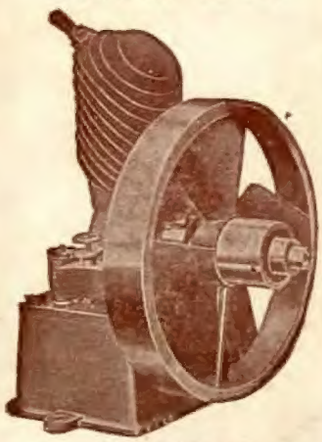
No. 7008 Rubber Covered Fixture Wire. No. 16 B. & S. Gauge. Price per 100 ft., $1.20

No. 8001 Main line switch & cut out with 2 fuses. Price, $0.45

Stable

No 2, 19 Light, 150 Watt

LIGHTING OUTFIT



No. 4600 ¼ H.P.

This outfit is the most flexible, and widely adaptable outfit we list. It forms an ideal plant for motor boats, automobiles, bungalows, camps, etc. The capacity of 19 lights is for the dynamo and engine, considering 8 C. P. 8 volt tungsten lamps being used. The outfit with 1 No. 555 storage battery can light 6 7, 6 volt, C. P. tungsten lamps for from 7 to 8 hours. The dynamo can easily recharge 2 No. 555, 60 A.H. batteries at once, and these 2 batteries would give twice the above C.P. output on discharge. The dynamo is shunt wound and very finely built, for constant duty.

The gasoline engine is a newly developed air cooled type, which has been adopted by the U. S. Government for many purposes including the driving of wireless generators. It is well made in every particular and develops ¼ H.P. easily, with speeds variable from 800 to 2000 R.P.M. Its net weight is 23 lbs. and it measures 12½" high, by 1 sq. ft. floor space. Cylinder has 1¾" bore by 1¾" stroke. The flywheel has a diameter of 8", the pulley a diameter of 1¾". It is air cooled by a fan built on the flywheel, 2 cycle type, jump spark ignition. Fuel tank in base. Shipping weight 35 lbs.

No. 4600 ¼ H.P. gasoline engine, complete with all ignition apparatus, including batteries and also muffler..... $23.00

No. 4610 The same engine but ½ H.P. with all ignition apparatus $35.00

No. 4620 Special 150 watt, 8 volt, 19 ampere, 2200 R.P.M. shunt wound dynamo. Price, complete with pulley $29.00

No. 4630 Automatic magnetic cut-out mounted on composition switchboard for preventing storage battery discharging back through dynamo. Price $9.00

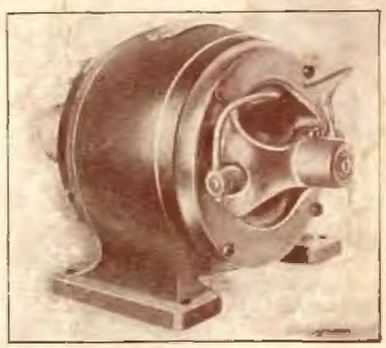
NO. 2. COMPLETE ELECTRIC LIGHTING OUTFIT.

Consisting of above No. 4620 150 watt dynamo, No. 4600 ¼ H.P. gasoline engine, No. 4630 automatic cut-out, and No. 555, 6 volt, 60 ampere hour storage battery, capable of lighting 6 to 7, 6 volt 6 C. P. lamps or their equivalent for 7 to 8 hours at each charge; 12 ft. 1" leather belting.

No. 2 Complete outfit as described, $70.00

No. 4700 Standard 250 volt, approved, 5 ampere snap switch. Price $0.25

No. 4701 Standard 10 ampere, 25 volt rating snap switch. Price $0.45



No. 4620. 150 Watts.

No. 4702 Standard Edison base, approved, brass key sockets for ½-inch pipe. Price $0.34

No. 4705 Porcelain Ceiling Rosettes for drop lights, approved. Price..... $0.25

No. 8003 Separable Attachment Plugs. Price..... $0.15

No. 8004 Edison Plug Fuses, 5, 10, or 20 ampere. Price..... $0.05

NOTE:—For the guidance of our customers, we have prepared a very simple and comprehensive blue-print showing the complete lay-out and all wiring connections, which is given gratis with all complete Electric Lighting Plants. For those who may wish a copy of this blue-print of valuable data, we send it postpaid at 10 cents.

If you are in doubt which of our lighting outfits is the most suitable for your purpose write us fully how you intend to use it. We gladly solicit your correspondence.

Power Plant